- UNOFFICIAL VERSION -

Departmental Examination Regulations (FPO-M)
for the

Master's Degree in

Nanoscience and Nanotechnology (NANO)

at the
University of Siegen

Dated 6 June 2023
Updated 29 October 2024

(Master's Degree Program in Nanoscience and Nanotechnology (NANO))

These regulations consolidate the current valid regulations as established in:

- *Fachprüfungsordnung (FPO-M) für das Fach Nanoscience and Nanotechnology (NANO) im Masterstudium an der Universität Siegen* dated 6 June 2023 (*Amtliche Mitteilung* 33/2023),
- *Ordnung zur Änderung der Fachprüfungsordnung (FPO-M) für das Fach Nanoscience and Nanotechnology (NANO) im Masterstudium an der Universität Siegen* dated 14 May 2024 (*Amtliche Mitteilung* 34/2024),
- *Zweiten Ordnung zur Änderung der Fachprüfungsordnung (FPO-M) für das Fach Nanoscience and Nanotechnology (NANO) im Masterstudium an der Universität Siegen* dated 29 October 2024 (*Amtliche Mitteilung* 69/2024).

Note: This English translation is provided solely for convenience; only the German version as formally published in an *Amtliche Mitteilung* from the University of Siegen is legally binding. In case of discrepancies, the German text shall prevail.

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Article 1
Scope

(1) These Departmental Examination Regulations, together with the General Examination Regulations for the Master's Degree (RPO-M) at the University of Siegen dated 28 February 2019 (*Amtliche Mitteilung* 5/2019), as amended, govern studies in the subject of nanoscience and nanotechnology.

(2) Nanoscience and nanotechnology is offered as a single subject degree program.

(3) Article 2 contains regulations for studies in the subject of nanoscience and nanotechnology.

Article 2

Regulations for the Single Subject Degree in Nanoscience and Nanotechnology

§ 1

Degree Program Model

The master's degree program in nanoscience and nanotechnology is available as a single subject degree program.

§ 2

Objectives for the Degree Program

The consecutive master's degree program in nanoscience and nanotechnology prepares students in accordance with a professional profile for researchers in the field of nanoscience and nanotechnology, leading them to acquire the fundamental qualifications required for independent work toward a doctoral program in physics, chemistry, or engineering, or to work in the nanoscience and nanotechnology industries. The goal of the degree program is to prepare leaders for roles in industry, science, government agencies, and academia.

Building on a first cycle university degree, the master's degree leads to the acquisition of analytical and methodological competencies in the field of nanoscience and nanotechnology. Graduates of the course possess in-depth knowledge and skills in the various physical, chemical, and technological subdisciplines of nanoscience. They are therefore able to successfully engage in interdisciplinary topics related to nanoscience and nanotechnology, including best practices for crucial global aspects such as the safe handling of nanotechnology (nanosafety). Graduates of the program are prepared for university and non-university basic research in the field of nanoscience. In particular, the interdisciplinary character of the degree program is designed to ensure that graduates are ready to perform research at the relevant junctions of the classical fields of physics, chemistry, and the engineering sciences. Graduates acquire basic knowledge and experimental methods applicable to several aspects of modern nanoscience, which enable them to work successfully in industrial and service companies. As part of the degree program in nanoscience and nanotechnology, students also gain competence with soft skills such as teamwork and social/intercultural interaction.

§ 3

Master's Degree

After successful completion of the course of study, the university awards the academic degree of Master of Science (M.Sc.).

§ 4

Special Admission Requirements

(1) Supplemental to § 4 RPO-M, admission to the master's degree program in nanoscience and nanotechnology requires proof of a first cycle degree in physics, chemistry, electrical engineering, or nanosciences from an institution of higher education subject to the German Basic Law, or a comparable first cycle degree from a higher educational institution. More detailed information is contained in the *Ordnung über die Eignungsfeststellung für den Masterstudiengang Nanoscience and Nanotechnology an der Universität Siegen*, dated 4 May 2017 (*Amtliche Mitteilung* 44/2017), as amended.

(2) The bachelor's degree must be a qualifying degree as defined in § 4 Para. 2 RPO-M. A bachelor's degree is considered qualifying if completed with a grade of 2.7 or better.

(3) One additional prerequisite for admission to the master's degree program in nanoscience and nanotechnology (non-teacher education) is proof of English-language proficiency at the B2 level under the Common European Framework of Reference for Languages (CEFR).

(4) Enrollment is barred to a candidate who has finally failed an examination in a degree program of notably similar content to the desired degree program and where the examination regulations define the examination in question as essential for the desired degree program.

§ 5

Time Abroad and Internships

Neither time abroad nor internships are mandatory.

§ 6

Examination Board

(1) To handle the responsibilities denoted in § 8 RPO-M and in this Article, Faculty IV: School of Science and Technology forms a Technical Examination Board for the single subject degree program nanoscience and nanotechnology. The Examination Board may, in its discretion, delegate tasks to the Office of Examinations.

(2) The Technical Examination Board comprises

a) Four members of the teaching faculty specializing in physics, chemistry, and electrical engineering (at least one from each field with a teaching chair),

b) one member of the academic staff, and

c) two members of the student body.

(3) The term of office for members of the teaching faculty and members from the academic staff totals three years. The term of office for members of the student body totals one year.

(4) For members pursuant to Paragraph 2, deputies are elected for each group in the event that appointed members are unable to attend, with a term of office based on Paragraph 3.

§ 7

Examiners, Independent Co-Examiners

(1) Authority to conduct examinations is governed by § 9 RPO-M.

(2) The role of independent co-examiner for oral examinations is restricted to persons who have already passed the corresponding examination or a *Diplom* or master's examination.

§ 8[*1]

Credit Point Requirements and Structure of the Degree Program

(1) Successful completion of the master's degree in nanoscience and nanotechnology requires 120 credit points (CP).

(2) The standard term of study totals four semesters. The course of studies may only be undertaken full time. The degree program may only be started in the winter semester.

(3) The structure of the master's degree program in nanoscience and nanotechnology varies based on the nature of the previously completed bachelor's degree. The course of study encompasses an alignment block (24 CP; cf. Paragraph 4 and Paragraph 5) based on the student's previous education; a general compulsory block comprising six modules (42 CP; 4NANOMA2 to 4NANOMA6 and 4ETMA357), the core elective block (24 CP; cf. Paragraph 6 in conjunction with Annex 4); and the master's thesis (30 CP; 4NANOMA7).

(4) Within the framework of the alignment blocks to be completed during the first semester, bachelor's degree holders in

1. Physics or comparable degree programs must complete modules 4CHEMMAEX04 ("General chemistry for physicists"), 4PHYMAEX02 ("Advanced solid-state physics for nanoscience"), 4ETMA358 ("Nanotechnology"), and 4NANOMA1 ("Graduate nano-seminar");
2. Chemistry or comparable degree programs must complete the modules 4PHYMAEX01 ("Solid-state physics for nanoscience"), 4PHYMAEX03 ("Quantum theory for nanoscience"), 4ETMA358 ("Nanotechnology"), and 4NANOMA1 ("Graduate nano-seminar");
3. Electrical Engineering or comparable degree programs must complete modules 4CHEMMAEX03 ("General chemistry for engineers"), 4PHYMAEX01 ("Solid-state physics for nanoscience"), 4PHYMAEX03 ("Quantum theory for nanoscience"), and 4NANOMA1 ("Graduate nano-seminar");
4. All candidates must complete a nanoscience degree program module from one of the other alignment blocks and the core elective courses encompassing 21 CP, as well as to the module 4NANOMA1 ("Graduate nano-seminar").

(5) If the levels of prior knowledge cannot be clearly identified, or in the case specified in Para. 4(4), then the Examination Board decides on a case-by-case basis as to which alignment block is assigned or, in the case specified in Para. 4(4), on which modules are to be taken. The decision is made based on the bachelor's degree that qualified

for admission. The modules must not have already been taken as part of the bachelor's degree program.

(6) From the core elective courses, four modules totaling 24 CP must be completed from the catalog in Annex 4. Modules selected and assigned by the Examination Board within the framework of the alignment block cannot be retaken.

(6a) A core elective module may also be selected as desired as 'interdisciplinary studies' from the general module catalog of Faculty IV at the University of Siegen. The module must be selected to provide 6 CP upon completion of the module. If more than 6 CP are acquired through the selected module, then only 6 CP from the selected module are accepted as "interdisciplinary studies." The module grades are calculated together with the recognized CP totals into the final grade.

(7) As an additional, freely electable offering for students, a seminar on current research topics in the nanosciences and nanotechnologies is organized.

(8) Module Overview:

No.	Module	CW[1]	EX[2]	CP[3]	C / CE[4]	Link to module description
Alignment block				24	C	
Alignment Block / Degree in Physics				24	C	
4CHEMMAEX04	General Chemistry for Physicists	1	1	9	C	FPO-M CHEM
4PHYMAEX02	Advanced solid-state physics for nanoscience	1	1	6	C	FPO-M PHY
4ETMA358	Nanotechnology	1	1	6	C	FPO-M ET
4NANOMA1	Graduate nano-seminar	0	1	3	C	Annex 7
Alignment Block / Degree in Chemistry				24	C	
4PHYMAEX01	Solid-state physics for nanoscience	1	1	9	C	FPO-M PHY
4PHYMAEX03	Quantum theory for nanoscience	1	1	6	C	FPO-M PHY
4ETMA358	Nanotechnology	1	1	6	C	FPO-M ET
4NANOMA1	Graduate nano-seminar	0	1	3	C	Annex 7
Alignment Block / Degree in Electrical Engineering				24	C	
4CHEMMAEX03	General Chemistry for Engineers	1	1	6	C	FPO-M CHEM
4PHYMAEX01	Solid-state physics for nanoscience	1	1	9	C	FPO-M PHY
4PHYMAEX03	Quantum theory for nanoscience	1	1	6	C	FPO-M PHY
4NANOMA1	Graduate nano-seminar	0	1	3	C	Annex 7
Alignment Block / Degree in Nanoscience				24	C	
	Modules encompassing 21 CP from the Nanoscience module catalog	0–4	3–4	21	C	Annex 7, FPO-M PHY, FPO-M CHEM, FPO-M ET
4NANOMA1	Graduate nano-seminar	0	1	3	C	Annex 7
General Compulsory Area				42	C	
4NANOMA2	Nanochemistry	1	1	6	C	Annex 7
4NANOMA3	Physics of nanoelectronic devices	1	1	6	C	Annex 7
4NANOMA4	Lab-course micro and nanotechnology	1	1	6	C	Annex 7
4NANOMA5	Lab-course Nanosynthesis, Nanosafety and Nanoanalytics	1	1	6	C	Annex 7
4NANOMA6	Research lab-course	0	1	12	C	Annex 7
4ETMA357	Photonic Devices	0	1	6	C	FPO-M ET
Core Electives				24	CE	
	4 modules of 6 CP each from “core elective modules” catalog	0–4	4	24	CE	Annex 4
4NANOMA7	Master’s Thesis	1	1	30	C	Annex 7

[1] CW = Coursework | [2] EX = Examination | [3] CP = Credit Points | [4] C/CE = Compulsory/Core Elective.

The recommended program semester (*Fachsemester*) is determined from the recommended course sequence (Annex 1).

(9) Potential instructional formats are: Lecture, exercise, lecture with exercise, lab, exercise with lab, lab course, research project, seminar. The concrete instructional format is listed in the module description.

(10) Instruction is conducted in English.

§ 9[*1]

Coursework and Examinations/Assessments:

(1) Supplemental to § 10 Para. 1 and § 11 Para. 6 RPO-M, the following formats are stipulated for coursework and examinations/assessments.

1. Coursework:

   a) Exercises (approx. 10 exercise sheets);

   b) Successful participation in exercises (active participation and/or submission of exercise sheets (approx. 10)). Form and scope of the coursework must be announced no later than four weeks after the start of the event.

   c) Active participation in the exercises, such as through routine submission, successful completion and/or presentation of solutions to exercise tasks;

   d) Reports (approx. 15 pages);

   e) Lab reports (approx. 15 pages);

   f) Experiment reports (approx. 15 pages);

   g) (Seminar) presentation (15 to approx. 30 min.)

   h) Attestations [*Testate*] (approx. 15 min.; written and oral test on content, procedure, and execution of labs);

   i) Oral interim report on the master's thesis (two presentations on the progress toward the master's thesis; approx. 30 min.);

   j) Lab course:
   All experiments for the lab must be completed. Furthermore, written lab reports (5–15 pages per experiment) must be prepared and submitted to the instructor. The results are presented as part of a colloquium or final discussion (15–30 minutes per examination);

   k) Lab:
   Attestations [*Testate*] (approx. 15 min.; written and oral test on content, procedure, and execution of labs) and experiment reports (approx. 15 pages) must be produced.

2. Examinations/Assessments:

   a) Exercises (approx. 10 exercise sheets);

   b) Reports (approx. 15 pages);

c) Lab reports (approx. 15 pages);

d) Experiment reports (approx. 15 pages);

e) Lecture followed by discussion (approx. 15 min. each);

f) Final report (approx. 30 pages).

(2) Prerequisite for admission to the examination in modules 4PHYMAEX01 to 4PHYMAEX03 as well as 4PHYMA20 to 4PHYMA23, 4PHYMA26, 4PHYMA27, 4PHYMA46, and 4PHYMA47 is the successful completion of the respective coursework for each module.

(3) The prerequisite for admission to the examination for the module 4NANOMA3 is the successful completion of the coursework for that module.

(4) The prerequisite for admission to the examination for the module 4ETMA358 is the successful completion of the coursework for that module.

(5) Based on which alignment block the student has been assigned, the prerequisite for admission to the module 4NANOMA5 is: for students with a prior degree in physics, successful completion of the coursework for module 4CHEMMAEX04; for students with a prior degree in electrical engineering, successful completion of the coursework for module 4CHEMMAEX03.

(6) The prerequisite for admission to the examination for the module 4CHEMMA37 is successful completion of the module 4CHEMMA09.

(7) The prerequisite for admission to the examination for the module 4CHEMMA38 is successful completion of the modules 4CHEMMA09 and 4CHEMMA37.

(8) The examination for module 4NANOMA6 is assessed by two university instructors.

§ 10[*1]

Repetition of Examinations/Assessments

(1) Repetition of examinations/assessments is governed by § 12 RPO-M.

(2) Appointments for repeating failed examinations/assessments must be offered twice.

(3) In the fourth semester, in derogation of § 12 para. 1(1) RPO-M, a completed examination credit may be repeated once in an effort to improve the grade. The attempt to improve the grade must be reported in writing to the Office of Examinations. Sentence 1 does not apply to module 4NANOMA7 (master's thesis).

Change to sentence 3 in Article 2 § 10 Para. 3

(valid from 1 October 2024):

Sentence 1 does not apply to modules that begin with the numbering "4ETMA" or module 4NANOMA4 to 4NANOMA7 (master's thesis).

(4) If a compulsory module has been finally failed, then the candidate may apply to the Examination Board within four weeks to take an oral supplemental examination in the finally failed module. The supplemental examination does not represent a stand-alone repetition of the examination. Participation in the oral supplemental examination may lead to a raising of the grade for the failed repeat examination to 4.0 (Sufficient [*ausreichend*]); no better grade may be achieved. This presumes that the

candidate has achieved the following semester-specific number of credit points by the end of the 1st, 2nd, 3rd, 4th, or 5th semester:

End of first semester: 15 credit points

End of second semester: 35 credit points

End of third semester: 55 credit points

End of fourth semester: 70 credit points

End of fifth semester: 84 credit points.

No supplemental examination is permitted after the sixth semester. The Examination Board decides on the application. If the application is approved, then the oral supplemental examination is conducted for at least 45 minutes in the presence of the chairperson of the Examination Board or their deputy. This supplemental examination cannot be repeated. Sentence 1 does not apply for modules that begin with the numbering "4ETMA."

(5) If an elective or core elective module is finally failed, then another module may be chosen once.

§ 10a

No-Penalty Attempt (*Freiversuch*)

(1) Examinations/assessments which are taken during the first examination phase after the semester specified in the recommended course sequence and which cannot be repeated pursuant to § 12 para. 5 RPO-M may, upon application by the student to the Office of Examinations, be assessed as a no-penalty attempt/"free shot" [*Freiversuch*], and repeated during the second examination phase.

(2) Paragraph 1 does not apply for the modules 4NANOMA4 to 4NANOMA7.

(3) If the repeated examination achieves a better grade than the prior attempt, then the prior attempt is considered not attempted and is replaced as an examination attempt by the repetition. If the repeated examination produces an equal or worse grade, then the grade from the previous attempt counts.

(4) An examination credit that was declared failed due to inappropriate behavior, and in particular an attempt to cheat, cannot be assessed as a no-penalty attempt/"free shot."

§ 11[*2]

Master's Thesis

(1) The master's thesis is worth 30 credit points (CP) toward the master's degree.

(2) Application for admission to the master's thesis must be submitted in writing or in an authenticated electronic format to the Examination Board. Admission to the master's thesis is governed by § 13 RPO-M.

(3) The master's thesis must cover a topic in the discipline of the nanosciences or nanotechnology. The candidate has the right to propose the topic of the thesis. The master's thesis may only be graded by a faculty member or a habilitated researcher.

(4) The master's thesis must be prepared in the English language. The allotted working time is 26 weeks. The length of the master's thesis should not exceed 70 pages. The topic of the master's thesis may only be changed once, and that within eight weeks after the topic is set.

(5) If the master's thesis is to be conducted at an institution outside the university, then the candidate must obtain permission from the chairperson of the Examination Board. The external institution must confirm in writing their acceptance of the regulations for the master's thesis.

(6) The master's thesis may not be registered until the respective alignment block as per § 8 for all modules in the first and second semester as per the recommended course sequence (see Annex 1) have been successfully completed for a total of 60 CP. The master's thesis must be registered no later than four weeks after the acquisition of 90 CP by completing all examinations in the alignment block, the general compulsory block, and the core elective block (cf § 8 Para. 3ff.).

(7) The thesis must contain a title page, table of contents, bibliography, and list of sources. Any portions of the work that quote other works, either verbatim or in their intellectual content, must be denoted as such, including a citation of the source. The candidate must add a written pledge to the thesis confirming that they completed it on their own, did not use any sources or aids other than those cited, and that all quotations are attributed as such.

(8) The master's thesis must be submitted as three copies in printed and bound form, as well as an electronic copy compatible with the search function (.pdf format) to the Examination Board for Nanoscience and Nanotechnology. The electronic form may be used to review the originality of the work using plagiarism detection software.

§ 12

Grades, Calculation of Grades

The assessment and calculation of grades is governed by § 21 RPO-M.

§ 13[*1]

Application and Transitional Rules

(1) These Departmental Examination Regulations apply for all students who have enrolled for the first time in this master's degree program at the University of Siegen starting with winter semester 2022/2023.

(2) The examination regulations for the degree program ending in a Master of Science in Nanoscience and Nanotechnology at the University of Siegen dated 19 April 2017 (*Amtliche Mitteilung* 32/2017), last amended by the *Zweite Ordnung zur Änderung der Prüfungsordnung für den Studiengang Nanoscience and Nanotechnology mit dem Abschluss Master of Science der Universität Siegen* dated 12 July 2021 (*Amtliche Mitteilung* 50/2021), expires on 30 September 2024. Students who were enrolled in the degree program in nanoscience and nanotechnology prior to winter semester 2022 may elect to complete their studies under those examination regulations until that date.

(3) Students who were already enrolled in the master's degree program in nanoscience and nanotechnology prior to winter semester 2022/2023 have the option to request that their studies be completed based on the stipulations of the General Examination Requirements for the Master's Degree (RPO-M) at the University of Siegen dated 28 February 2019 (*Amtliche Mitteilung* 5/2019) as amended, as well as these Departmental Examination Regulations. This application must be submitted to the relevant Examination Board and cannot be withdrawn.

Article 3

Regulations for Nanoscience and Nanotechnology as a Degree Component in a Combination Degree Program (Non-Teacher Education):

Not applicable.

Article 4

Regulations for Teacher Education Degree Program

Not applicable.

Article 5

Cross-Departmental Export Modules

Not applicable.

Article 6

Entry into Effect and Publication

(...)

This set of regulations governs the entry into effect of the original department examination regulations. This unofficial public notice [*Bekanntmachung*] contains the version as amended on 1 April 2024 and 1 October 2024.

Annexes

Recommended Course Sequences

Annex 1: Recommended course sequences by degree model for single subject degree programs in Article 2

During the first semester, the program is divided into three distinct tracks, reflecting the prior knowledge of the students. Assignment to one of the three tracks is made based on the student's prior knowledge and by decision of the Examination Board. Through this, students acquire a fundamental understanding of the other respective sub-disciplines of the nanosciences. During the first semester, all three tracks share a course in the area of research in the nanosciences that explores, among other things, key topics in nanotechnology. During the second semester, there are mandatory courses in "Nanochemistry" and "Physics of Nanoelectronic Devices." Two labs are foreseen: "Micro and Nanotechnology" and "Nanosynthesis, Nanosafety, and Nanoanalytics," which covers the experimental methods of nanoscience as well as important global aspects such as safe handling of nanotechnology ("nanosafety") in Siegen. In the third semester, students have the opportunity to select from a broad catalog of core elective courses, while at the same time a research lab shall be conducted within the working groups in preparation of the master's thesis. The fourth semester is dedicated exclusively to the master's thesis.

Single Subject Degree Program (full time)

Bachelor in Physics	**1st Year of Study**		**2nd Year of Study**	
Module No.	**1st Program Semester (Winter semester)**	**2nd Program Semester (Summer semester)**	**3rd Program Semester (Winter semester)**	**4th Program Semester (Summer semester)**
4CHEMMAEX04	9 CP			
4PHYMAEX02	6 CP			
4ETMA358	6 CP			
4NANOMA1	3 CP			
Free selection from the core electives module	6 CP			
4NANOMA2		6 CP		
4NANOMA3		6 CP		
4NANOMA4		6 CP		
4NANOMA5		6 CP		
Free selection from the core electives module		6 CP		
4ETMA357			6 CP	
Free selection from the core electives module			6 CP	
Free selection from the core electives module			6 CP	
4NANOMA6			12 CP	
4NANOMA7				30 CP
CP total	**30 CP**	**30 CP**	**30 CP**	**30 CP**

Bachelor in Chemistry	**1st Year of Study**		**2nd Year of Study**	
Module No.	**1st Program Semester (Winter semester)**	**2nd Program Semester (Summer semester)**	**3rd Program Semester (Winter semester)**	**4th Program Semester (Summer semester)**
4PHYMAEX01	9 CP			
4PHYMAEX03	6 CP			
4ETMA358	6 CP			
4NANOMA1	3 CP			
Free selection from the core electives module	6 CP			
4NANOMA2		6 CP		
4NANOMA3		6 CP		
4NANOMA4		6 CP		
4NANOMA5		6 CP		
Free selection from the core electives module		6 CP		
4ETMA357			6 CP	
Free selection from the core electives module			6 CP	
Free selection from the core electives module			6 CP	
4NANOMA6			12 CP	
4NANOMA7				30 CP
CP total	**30 CP**	**30 CP**	**30 CP**	**30 CP**

Bachelor in Electrical Engineering	**1st Year of Study**		**2nd Year of Study**	
Module No.	**1st Program Semester (Winter semester)**	**2nd Program Semester (Summer semester)**	**3rd Program Semester (Winter semester)**	**4th Program Semester (Summer semester)**
4CHEMMAEX03	6 CP			
4PHYMAEX01	9 CP			
4PHYMAEX03	6 CP			
4NANOMA1	3 CP			
Free selection from the core electives module	6 CP			
4NANOMA2		6 CP		
4NANOMA3		6 CP		
4NANOMA4		6 CP		
4NANOMA5		6 CP		
Free selection from the core electives module		6 CP		
4ETMA357			6 CP	
Free selection from the core electives module			6 CP	
Free selection from the core electives module			6 CP	
4NANOMA6			12 CP	
4NANOMA7				30 CP
CP total	**30 CP**	**30 CP**	**30 CP**	**30 CP**

Bachelor in Nanosciences	**1st Year of Study**		**2nd Year of Study**	
Module No.	**1st Program Semester (Winter semester)**	**2nd Program Semester (Summer semester)**	**3rd Program Semester (Winter semester)**	**4th Program Semester (Summer semester)**
Modules as per § 8 Paragraph 4 No. 4	21 CP total			
4NANOMA1	3 CP			
Free selection from the core electives module	6 CP			
4NANOMA2		6 CP		
4NANOMA3		6 CP		
4NANOMA4		6 CP		
4NANOMA5		6 CP		
Free selection from the core electives module		6 CP		
4ETMA357			6 CP	
Free selection from the core electives module			6 CP	
Free selection from the core electives module			6 CP	
4NANOMA6			12 CP	
4NANOMA7				30 CP
CP total	**30 CP**	**30 CP**	**30 CP**	**30 CP**

Annex 2: Recommended course sequences by degree model for combination degree programs (non-teacher education) in Article 3

Not applicable.

Annex 3: Recommended course sequences by degree model in teacher education in Article 4

Not applicable.

Core Elective Modules

Annex 4: List of core elective modules pursuant to Article 2 § 8 Para. 3*1.2

No.	Module	CW[1]	EX[2]	CP[3]	Link to module description
Core Elective Modules FPO-M NANO					
4NANOMA8	Nano-Biophotonics	0	1	6	Annex 7
4NANOMA9	Scientific Programming with Python including Applications of Machine Learning, FAIR data and Network Programming	1	1	6	Annex 7
Core Elective Modules FPO-M PHYSIK					
4PHYMA20	Modern Methods in X-Ray Physics	1	1	6	FPO-M PHY
4PHYMA21	Solid State Physics in Nanostructures	1	1	6	FPO-M PHY
4PHYMA22	Theory of Condensed Matter	1	1	6	FPO-M PHY
4PHYMA23	X-Ray Tomography	1	1	6	FPO-M PHY
4PHYMA26	Nano-Optics	1	1	6	FPO-M PHY
4PHYMA27	Experimental Methods of Quantum and Nano-Optics	1	1	6	FPO-M PHY
4PHYMA46	Quantum Optics at the Nano-Scale	1	1	6	FPO-M PHY
4PHYMA47	Physics of Organic and Soft Matter	1	1	6	FPO-M PHY
4PHYMA50	Instrumentation in Synchrotron Radiation Research at Large-Scale Facilities	0	1	6	FPO-M PHY
4PHYMA51	Data Analysis and Data Management in Synchrotron Radiation Research	1	1	6	FPO-M PHY
4PHYMA54	Crystallography	1	1	6	FPO-M PHY

4PHYMA55	Computational Methods in Solid State Physics	1	1	6	FPO-M PHY
Core Elective Modules FPO-M CHEMISTRY					
4CHEMMA01	Advanced Inorganic Chemistry	0	1	6	FPO-M CHEM
4CHEMMA09	Polymer Chemistry I – Properties of Polymers	0	1	6	FPO-M CHEM
4CHEMMA14	Materials for Energy Storage and Conversion	0	1	6	FPO-M CHEM
4CHEMMA15	Advanced Magnetic Resonance Spectroscopy – Pulse Methods	0	1	6	FPO-M CHEM
4CHEMMA16	Advanced Magnetic Resonance Spectroscopy – Spectra of Solids	0	1	6	FPO-M CHEM
4CHEMMA17	Nanostructured Materials	1	1	6	FPO-M CHEM
4CHEMMA18	Applied Optical Spectroscopy	1	1	6	FPO-M CHEM
4CHEMMA23	Physics and Chemistry of Interfaces	1	1	6	FPO-M CHEM
4CHEMMA24	Atomic Force Microscopy for Materials and Interfaces	1	1	6	FPO-M CHEM
4CHEMMA25	Physical Chemistry of Nanostructured and Soft Materials	1	1	6	FPO-M CHEM
4CHEMMA26	Methods and Techniques of Surface Analysis	1	1	6	FPO-M CHEM
4CHEMMA34	Biochemistry of Surfaces	1	1	6	FPO-M CHEM
4CHEMMA35	Metal Oxides – Corrosion and Application in Renewable Energies	1	1	6	FPO-M CHEM
4CHEMMA36	Hybrid Nanomaterials	1	1	6	FPO-M CHEM
4CHEMMA37	Polymer Chemistry II – Syntheses of Polymers	0	1	6	FPO-M CHEM
4CHEMMA38	Advanced Topics in Polymer Chemistry	0	1	6	FPO-M CHEM
Core Elective Modules FPO-M ELECTRICAL ENGINEERING					
4ETMA300	Semiconductor Electronics Design	1	1	6	FPO-M ET
4ETMA302	Analogue Integrated Circuits	1	1	6	FPO-M ET
4ETMA350	Microelectronics Sensors	0	1	6	FPO-M ET
4ETMA351	Advanced Analogue Circuits	1	1	6	FPO-M ET

4ETMA352	Advanced Semiconductor and Microelectronics	1	1	6	FPO-M ET
4ETMA353	Radio Frequency IC Design	1	1	6	FPO-M ET
4ETMA358	Nanotechnology	1	1	6	FPO-M ET

Annex 5: List of core elective modules pursuant to Article 3 § 8 para. 4

Not applicable.

Annex 6: List of core elective modules pursuant to Article 4 § 8 para. 4

Not applicable.

Module Descriptions

Annex 7: Module Descriptions for Article 2–4[*1,2]

If a module is used in different degree programs or degree components, then the status may vary between "Compulsory" or "Core Elective" depending on the degree program or degree component. The binding status is determined in the module overview in § 8 and the Annex "Core Elective Modules" of the respective FPO.

No.	4NANOMA1		
Module Title	Graduate Nano-Seminar		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	WS		
Language of Instruction	English		
Credit Points	3		
Weekly Contact Hours	2		
On-Campus Study	30 h		
Independent Study	60 h		
Workload	90 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Seminar	Graduate nano-seminar	20	2
Academic Requirements	**Format**		**Length / Scope**
Examinations	Comprehensive examination credit comprised of: 1. Lecture with follow-on discussion (50%) and 2. Written protocol (50%)		15–30 Min. Approx. 15 pages
Coursework	None		
Learning Outcomes	Students know how to prepare themselves for and to conduct a scientific lecture. Students learn about the latest developments in the nanosciences. Students learn the fundamentals of scientific discussion and learn how to write a summary of their research into scientific literature. Ability to conceive of abstract concepts, recognize complex problems, apply advanced insights and abilities to interdisciplinary and transdisciplinary discussions on complex topics and to debate and discuss these in English.		

Course Content	Seminar with student presentations on new topics in the nanosciences and nanotechnology, followed by discussion. The students will record the content of the lectures in a written protocol.
Applicability in the following degree programs	MA Nanoscience and Nanotechnology
Prerequisites for Participation	None
Prerequisites for Awarding of CP	Passing the examinations

No.	4NANOMA2		
Module Title	Nanochemistry		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	SS		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60 h		
Independent Study	120 h		
Workload	180 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Exercise	Nanochemistry	20	2
Lecture	Nanochemistry	20	2
Academic Requirements	**Format**		**Length / Scope**
Examinations	Written examination		120 min.
Coursework	Exercises		
Learning Outcomes	Students: • are familiar with fundamental concepts and methods of nanochemistry • can describe the relationship between nanostructure, composition, and properties • can apply the fundamental concepts of chemistry and physics • can describe and categorize approaches to the synthesis and production of nano-scale structures and systems • can compare methods and develop strategies to synthesize, produce, and modify nanoscale structures and systems • are familiar with the fundamentals of nanotoxicity and sustainable nanochemistry		
Course Content	Principles of nanochemistry. Description of structure, composition, and properties, synthesis and characterization of materials and nanomaterials (nanoparticles, nanorods, nanotubes, nanowires), chemical micro- and nanostructuring, conventional and unconventional lithography, self-organization principles, microspheres, micro- and mesoporous materials, self-organization and self-assembly of molecules, films, block copolymers and microscale objects, nanoscale machines and devices, bio-nanochemistry, selected examples of nanochemistry research from newer literature. Introduction to nanotoxicity and sustainable nanochemistry.		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation	None		
Prerequisites for Awarding of CP	Passing the examinations		

No.	4NANOMA3		
Module Title	Physics of Nanoelectronic Devices		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	SS		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60 h		
Independent Study	120 h		
Workload	180 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Lecture	Physics of Nanoelectronic Devices	20	2
Exercise	Physics of Nanoelectronic Devices	20	2
Academic Requirements	**Format**		**Length / Scope**
Examinations	Written examination		120 min
Coursework	Successful participation in the exercises		
Learning Outcomes	Students are familiar with the concepts and methods of solid state and nano physics and understand the concept/application of nanoelectrical apparatuses. They understand the foundation of current related research topics in the nanosciences. Ability to conceive of abstract concepts, recognize complex problems, apply advanced insights and abilities to interdisciplinary and transdisciplinary discussions on complex topics and to debate and discuss these in English.		
Course Content	Advanced course on: crystalline structure of solids, elastic properties, phonons, electronic band structures of solids, p-n junctions, electronic elements such as diodes, LED, and MOSFETs, solid body magnetism and magnetic elements, electronic band structure in the nano-range, application in nano-electronics.		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology MA European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors		
Prerequisites for Participation	Formal: The prerequisite for admission to the examination is passing the coursework for the module. Content: None		
Prerequisites for Awarding of CP	Passing coursework and examination.		

No.	4NANOMA4		
Module Title	Lab-course micro and nanotechnology		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	SS		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60 h		
Independent Study	120 h		
Workload	180 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Lab	Lab-course micro and nanotechnology	15	4
Academic Requirements	**Format**		**Length / Scope**
Examinations	Lab Report		Approx. 15 pages
Coursework	Attestations [*Testate*]		Approx. 15 min.
Learning Outcomes	Students are familiar with the fundamental experimental concepts and methods to produce and characterize micro and nano components and know how the devices and equipment at the University of Siegen are to be used. After completion of the course, students will be capable of explaining • the production steps for a micro or nano component • which process steps are required for the respective procedure • how the primary process steps function • which physical principles represent limitations for the production and scaling of a micro or nano component.		
Course Content	In this lab course, students learn methods/processes and practical handling of devices and equipment required to produce a micro/nano component. This includes, for example: Cleaning processes, lithography, physical vapor deposition (PVD), etching, etc. In this lab course, the students will • produce a simple micro or nano structure, • characterize this structure, • measure the electrical properties of a sub-micron semiconductor element in one of the research environments provided by the University of Siegen and • record their findings in a lab report.		
Applicability in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation	None		
Prerequisites for Awarding of CP	Passing coursework and examination.		

No.	4NANOMA5		
Module Title	Lab Course on Nanosynthesis, Nanosafety and Nanoanalytics		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	SS		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60 h		
Independent Study	120 h		
Workload	180 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Lab	Lab Course on Nanosynthesis, Nanosafety and Nanoanalytics	15	4
Academic Requirements	**Format**		**Length / Scope**
Examinations	Lab report		Approx. 15 pages
Coursework	Attestations [*Testate*]		Approx. 15 min.
Learning Outcomes	Students are familiar with the fundamental experimental concepts and methods of the nanosciences and nanotechnology at the University of Siegen. Beyond this, they acquire the fundamental concepts of nanosafety. Ability to conceive of abstract concepts, recognize complex problems, apply advanced insights and abilities to interdisciplinary and transdisciplinary discussions on complex topics, and to debate and discuss these in English.		
Course Content	Introduction to nanosafety. Lab course for nanostructure synthesis and analytics, with data analysis. Synthesis of nanostructures and their characterization using Raman spectroscopy, x-ray, dynamic light scattering, REM, TEM, etc.		
Applicability in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation	Based on which alignment block the student has been assigned, the prerequisite for admission to the module 4NANOMA5 is: for students with a prior degree in physics, passing the coursework for the module 4CHEMMAEX04; for students with a prior degree in electrical engineering, passing the coursework for 4CHEMMAEX03.		
Prerequisites for Awarding of CP	Passing coursework and examination.		

No.	4NANOMA6		
Module Title	Research Lab Course		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	Both semesters		
Language of Instruction	English		
Credit Points	12		
Weekly Contact Hours	0		
On-Campus Study	0 h		
Independent Study	360 h		
Workload	360 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Degree Project	Research Lab Course		8
Academic Requirements	**Format**		**Length / Scope**
Examinations	Final report		Approx. 30 pages
Coursework	None		
Learning Outcomes	Students apply scientific strategies to the selected research topics. Students can develop and execute experiments independently on the basis of literary research. Interdisciplinary assessment, literary research and presentation techniques, organization and management of a research project, ability to work within an international (and intercultural) team, presentation of the results of an academic investigation to an expert audience, conduct debate and discussion in English, database search of literature, analysis of scientific work, presentation techniques. The examination will be assessed by two members of the teaching faculty.		
Course Content	Literature research, formulation of measurement/synthesis/technology strategies, integration into current research topics, lab reports, and critical assessments of the results.		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation			
Prerequisites for Awarding of CP	Passing the examinations		

No.	4NANOMA7		
Module Title	Master's Thesis		
Compulsory/Core Elective	C		
Module Length	1 semester		
Frequency	Every semester		
Language of Instruction	English		
Credit Points	30		
Weekly Contact Hours			
On-Campus Study	0 h		
Independent Study	900 h		
Workload	900 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
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Academic Requirements	**Format**		**Length / Scope**
Examinations	Master's Thesis		26 weeks, max. 70 pages
Coursework	Two oral interim reports on the master's thesis		Approx. 30 min.
Learning Outcomes	Students can select a current research topic from a selected area of physics, chemistry, or the engineering sciences. They can administer and document their own research project and present their findings to an expert audience. The students are familiar with and can apply suitable working methods and instruments for scientific research and possess comprehensive competency in scientific perspectives. Interdisciplinary assessment, literary research, organization and administration of a scientific project, ability to work in international (and intercultural) research groups, presentation of findings of a scientific investigation to an expert audience, debate and discussion in English.		
Course Content	In the master's thesis, the candidate must work through and then present, orally and in writing, a problem from their field of studies, independently and using scientific methods, within a prescribed deadline.		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation	The master's thesis can only be registered once all modules of the 1st and 2nd semester as per the respective recommended course sequences (see Annex 1) and in accordance with the respective alignment block pursuant to § 8 have been successful completed, with a scope of 60 CP in total.		
Prerequisites for Awarding of CP	Passing the examinations		

No.	4NANOMA8		
Module Title	Nano-Biophotonics		
Compulsory/Core Elective	CE		
Module Length	1 semester		
Frequency	Offered occasionally		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60 h		
Independent Study	120 h		
Workload	180 h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group Size**	**Weekly Contact Hours**
Exercise	Nano-Biophotonics	20	2
Lecture	Nano-biophotonics	20	2
Academic Requirements	**Format**		**Length / Scope**
Examinations	Written examination or Oral examination Form and scope of the examination credit will be announced no later than four weeks after the start of the course.		120 min. or 30–45 Min.
Coursework	None		
Learning Outcomes	Students are familiar with and are capable of applying advanced concepts from the field of nano-biophotonics, especially in the areas of microscopy, spectroscopy, and bio-sensorics. They are familiar with current scientific developments.		
Course Content	Light-matter interactions, light microscopy, molecular spectroscopy, biological markers and functionalization methods for DNA technology, cells and organic tissues, nanophotonics, fluorescence reinforcement of surface-reinforced Raman scattering, high-resolution optical microscopy, atomic force microscope.		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation	Subject: Electro-dynamics, non-relativistic quantum mechanics Formal: none		
Prerequisites for Awarding of CP	Passing the examinations		

No.	4NANOMA9		
Module Title	Scientific Programming with Python (including applications of machine learning, FAIR data and network programming)		
Compulsory/Core Elective	CE		
Module Length	2 semesters		
Frequency	Offered occasionally		
Language of Instruction	English		
Credit Points	6		
Weekly Contact Hours	4		
On-Campus Study	60h		
Independent Study	120h		
Workload	180h		
Instructional Format	**Courses/Module Elements (if applicable)**	**Group size**	**Weekly Contact Hours**
Lecture	Scientific programming with Python including applications of machine learning, FAIR data and network programming	20	2
Exercise	Scientific programming with Python including applications of machine learning, FAIR data and network programming	20	2
Academic Requirements	**Format**		**Length / Scope**
Examinations	Written examination		180 Min.
Coursework	Exercises		
Learning Outcomes	Students are familiar with the core concepts of python, both from the view of data science and for industrial programming. They learn concepts of Python, machine learning, and computer networks through practical programming exercises with scientific data sets of synchrotron and FEL radiation. Students acquire the ability to analyze complex data and large data sets from experiments in the fields of x-ray and nanotechnology research. Students are familiar with the concept of FAIR data and data management and understand how this is handled in the DAPHNE4NFDI project.		
Course Content	Introduction to Python: Variables, data types, loops, arrays, functions Classes and objects, inheritance, data processing, NumPy, Pandas, and Matplotlib. Machine learning: Supervised and unsupervised learning technologies, Scikit-learn, Tensorflow, SciPy, development and training of neural nets. Networks and hardware: Network services in Python, TPC/IP protocol, socket programming. FAIR data: Collection of meta-data, electronic logbooks, data repositories, data management plans		
Applicable in the following degree programs	MA Nanoscience and Nanotechnology		
Prerequisites for Participation			
Prerequisites for Awarding of CP	Passing coursework and examinations		

[*1] Article 2 § 8, § 9, § 10, § 13, Annex 4 and Annex 7 amended by the *Ordnung zur Änderung der Fachprüfungsordnung (FPO-M) für das Fach Nanoscience and Nanotechnology (NANO) im Masterstudium an der Universität Siegen* dated 14 May 2024 (*Amtliche Mitteilung 34/2024*), entered into effect on 1 April 2024 and 1 October 2024, ratified on 8 May 2024.

[*2] Article 2 § 11, Annex 4 and Annex 7 amended by the *Zweite Ordnung zur Änderung der Fachprüfungsordnung (FPO-M) für das Fach Nanoscience and Nanotechnology (NANO) im Masterstudium an der Universität Siegen* dated 29 October 2024 (*Amtliche Mitteilung 69/2024*), entered into effect on 1 October 2024, ratified on 9 October 2024.

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