AALBORG UNIVERSITET

CURRICULUM FOR THE MASTER'S PROGRAMME IN ENGINEERING (PHYSICS AND TECHNOLOGY), 2023

MASTER OF SCIENCE (MSC) IN ENGINEERING
AALBORG

Link to this studyline

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§ 1: PREFACE

Pursuant to consolidation Act 778 of August 7, 2019 on Universities (the University Act), the following is established. The programme also follows the Examination Policies and Procedures incl. the Joint Programme Regulations for Aalborg University.

§ 2: BASIS IN MINISTERIAL ORDERS

The Master's programme is organised in accordance with the Ministry of Higher Education and Science's Order no. 2285 of December 1, 2021 on Full-time University Programmes (the University Programme Order) and Ministerial Order no. 2271 of December 1, 2021 on University Examinations (the Examination Order). Further reference is made to Ministerial Order no. 35 of January 13, 2023 (the Admission Order) and Ministerial Order no. 1125 of July 4, 2022 (the Grading Scale Order).

§ 3: CAMPUS

The programme is offered in Aalborg.

§ 4: FACULTY AFFILIATION

The Master's programme falls under the The Faculty of Engineering and Science, Aalborg University.

§ 5: STUDY BOARD AFFILIATION

The Master's programme falls under the Study Board of Mechanical Engineering and Physics.

§ 6: AFFILIATION TO CORPS OF EXTERNAL EXAMINERS

The Master's programme is associated with the external examiners corps on Civil engineering corps of external examiners.

§ 7: ADMISSION REQUIREMENTS

Applicants with a legal claim to admission (retskrav):

- Bachelor of Science in Nanotechnology with specialization in Physics, Aalborg University

Applicants with one of the following degrees are entitled to admission:

- Bachelor of Science in Nanotechnology with specialization in Biotechnology, Aalborg University
- Bachelor of Science in Physics, Aalborg University
- Bachelor of Science in Nanotechnology, Aalborg Univeristy
- Bachelor of Science in Nanoscience, Aarhus University
- Bachelor of Science in Nanoscience, University of Copenhagen
- Bachelor of Science in Physics and Nanotechnology, Technical University of Denmark

All applicants must, as a minimum, document English language qualifications comparable to an "English B level" in the Danish upper secondary school (gymnasium) (cf. the Admission Order).

Admission to the master's programme in Physics and Technology requires that the applicant has passed a relevant qualifying bachelor's or professional bachelor's degree programme in Engineering. A bachelor's or professional bachelor's degree programme in Engineering is defined as relevant if the degree programme provides competencies to a minimum of ECTS within the following subject areas:

Common:

Physics: from around 10 ECTS – approx. 50 ECTS

- General physics covering: mechanics and thermodynamics, Optics and spectroscopy, electrical circuits and basics of electromagnetism

Chemistry: from around 5-10 ECTS

- General chemistry, materials science or solid state physics/chemistry

Mathematics: from min. 5 ECTS – approx. 20 ECTS

- Calculus

In addition, each of the two specializations have the following criteria

Specialization in Nanobiotechnology:

Chemistry: From min. 20 ECTS – approx. 80 ECTS

- Inorganic and general chemistry
- Organic chemistry
- Physical chemistry (thermodynamics/kinetics/quantum chemistry)
- Biochemistry/proteins/DNA/lipids

Physics: From around 10 ECTS – approx. 50 ECTS

- General physics covering: Mechanics and thermodynamics, optics and spectroscopy and electrical circuits and basics of electromagnetism

Mathematics: From min. 5 ECTS – approx. 20 ECTS

- Calculus

Biology/Biotechnology: From min. 5 ECTS – approx. 20 ECTS

- Microbiology/cellular systems/molecular cell biology/molecular biology

The competences can come from courses, projects, or lab exercises.

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialization in Nanomaterials and Nanophysics:

Mathematics: The general fields of

- Calculus
- Linear algebra
- Vector calculus
- Differential equations
- Numerical methods

should be covered to a combined extent of 10-20 ECTS

Physics: The general fields of

- Classical physics
- Mechanics
- Thermodynamics
- Electromagnetism

- Optics
- Solid state physics

should be covered to a combined extent of 20-60 ECTS

Chemistry and Materials: Some of the general fields of

- Chemistry
- Engineering Materials
- Manufacturing and processing methods
- Biomaterials
- Polymers and plastics
- Nanomaterials
- Nano technology

should be covered to a combined extent of 10-25 ECTS

Application of the above disciplines through e.g. project work (as part of the applicant BSc-curriculum) counts towards the combined ECTS extent.

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

§ 8: THE PROGRAMME TITLE IN DANISH AND ENGLISH

The Master's programme entitles the graduate to one of the following titles:

- Civilingeniør, cand.polyt. i fysik og teknologi med specialisering i nanobioteknologi. The English designation is: Master of Science (MSc) in Engineering (Physics and Technology with specialisation in Nanobiotechnology)
- Civilingeniør, cand.polyt. i fysik og teknologi med specialisering i nanomaterialer og nanofysik. The English designation is: Master of Science (MSc) in Engineering (Physics and Technology with specialisation in Nanomaterials and Nanophysics)

§ 9: PROGRAMME SPECIFICATIONS IN ECTS CREDITS

The Master's programme is a 2-year, research-based, full-time study programme. The programme is set to 120 ECTS credits.

§ 10: RULES CONCERNING CREDIT TRANSFER (MERIT), INCLUDING THE POSSIBILITY FOR CHOICE OF MODULES THAT ARE PART OF ANOTHER PROGRAMME AT A UNIVERSITY IN DENMARK OR ABROAD

The Study Board can approve that passed programme elements from other educational programmes at the same level replaces programme elements within this programme (credit transfer).

Furthermore, the Study Board can, upon application, approve that parts of this programme is completed at another university or a further education institution in Denmark or abroad (pre-approval of credit transfer).

The Study Board's decisions regarding credit transfer are based on an academic assessment.

§ 11: EXEMPTIONS

The Study Board's possibilities to grant exemption, including exemption to further examination attempts and special examination conditions, are stated in the Examination Policies and Procedures published at this website: https://www.studyservice.aau.dk/rules

§ 12: RULES FOR EXAMINATIONS

The rules for examinations are stated in the Examination Policies and Procedures published at this website: https://www.studyservice.aau.dk/rules

§ 13: RULES CONCERNING WRITTEN WORK, INCLUDING THE MASTER'S THESIS

In the assessment of all written work, regardless of the language it is written in, weight is also given to the student's formulation and spelling ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are taken as a basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination can be assessed as 'Pass' on the basis of good language performance alone; similarly, an examination normally cannot be assessed as 'Fail' on the basis of poor language performance alone.

The Study Board can grant exemption from this in special cases (e.g., dyslexia or a native language other than Danish).

The Master's Thesis must include an English summary. If the project is written in English, the summary can be in Danish. The summary is included in the evaluation of the project as a whole.

§ 14: REQUIREMENTS REGARDING THE READING OF TEXTS IN A FOREIGN LANGUAGE

It is assumed that the student can read academic text and use reference works, etc., in English.

§ 15: COMPETENCE PROFILE ON THE DIPLOMA

The following competence profile will appear on the diploma:

A Candidatus graduate has the following competency profile:

A Candidatus graduate has competencies that have been acquired via a course of study that has taken place in a research environment.

A Candidatus graduate is qualified for employment on the labour market based on his or her academic discipline as well as for further research (PhD programmes). A Candidatus graduate has, compared to a Bachelor, developed his or her academic knowledge and independence so as to be able to apply scientific theory and method on an independent basis within both an academic and a professional context.

§ 16: COMPETENCE PROFILE OF THE PROGRAMME

Competence profile of the programme

Students graduating with a Master's degree in Physics and Technology have acquired the following knowledge, skills and competencies:

Knowledge:

- Has attained thorough understanding and can reflect on a scientific level over theory, methods and experiments within the area of materials physics and technology.
- Demonstrate an understanding of research work and be able to become a part of the research environment.
- Demonstrate insight into the implications of research work, including research ethics.
- Has knowledge on the highest international research level in several subject areas within the fields of characterization and processing, synthesis and modeling of materials and/or nanobiostructures on different scales.

Students with specialization in Nanomaterials and Nanophysics have:

- Has attained thorough understanding of a broad range of theoretical and experimental techniques within the area of nanotechnology.
- Has knowledge on the highest international research level in several subject areas within, within the field of nanotechnology.

Students with specialization in Nanobiotechnology have:

- Has knowledge in the major areas within nanobiotechnology that covers advanced gene technology, reaction engineering, high throughput systems, molecular electronics, molecular simulations, self-assembling systems, reaction at interfaces, and spectroscopic methods such as MS and NMR.

Skills:

- Be able to apply a wide range of engineering and scientific methods within relevant topics of physics and technology.
- Be able to perform scientific work in relevant topics of the field of specialization.
- Can select and apply appropriate theories, methods and tools to solve a wide range of problems within the field of specialization.
- Can communicate research-based knowledge and discuss professional and scientific problems with both peers and non specialists.
- Can evaluate and select among scientific theories, methods, tools and general skills and, on a scientific basis, advance new analyses and solutions within physics and technology.
- Can use advanced laboratory equipment, test setups and data collection methods.

Students with specialization in nanomaterials and nanophysics have additional skills in:

- Be able to apply specific methods of materials fabrication and characterization on the nanoscale.
- Be able to choose appropriate theoretical approaches for the description and modeling of nanomaterials and nanostructures.
- Can discuss the nanoscale phenomena with peers and non-experts.

Students with specialization in nanobiotechnology have additional skills in:

- Should be able to apply up-to-date methods to describe and solve problems on a scientific level within nanobiotechnology.

Competencies:

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialization.
- Be able to take part in technical development and research.
- Can manage work and development situations that are complex, unpredictable and require new solutions.
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility.
- Be competent to solve new and complicated technical problems by the use of advanced mathematic, scientific and technological knowledge.
- Can independently take responsibility for own professional development and specialization.
- Can evaluate and select digital tools based on their appropriateness to specific tasks within the specialization.

Students with specialization in Nanomaterials and Nanophysics have additional competences in:

- Are able to participate in or lead projects involving nanotechnology, semiconductors and / or optical nanostructures.

Students with specialization in Nanobiotechnology have additional competences in:

- Can evaluate and select digital tools based on their appropriateness to specific tasks within nanobiotechnology.

§ 17: STRUCTURE AND CONTENTS OF THE PROGRAMME

The master's programme aims at educating graduates, who are qualified to take part in technical development and research and who are able to direct the technical management of development projects within the industry.

The program is structured in modules and organized as a problem-based study. A module is a program element or a group of program elements, which aims to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluding with one or more examinations within specific exam periods that are defined in the curriculum.

The program is based on a combination of academic, problem-oriented and interdisciplinary approaches and organized based on the following work and evaluation methods that combine skills and reflection:

- lectures
- classroom instruction
- project work
- workshops
- exercises (individually and in groups)
- teacher feedback
- reflection
- portfolio work

AAU Micro
AAU Micro are small e-learning modules of limited, well-defined scope. AAU Micro modules are extra-curricular but may be employed to support learning in curricular course and project modules.

§ 18: OVERVIEW OF THE PROGRAMME

All modules are assessed through individual grading according to the 7-point scale *or* Pass/Fail. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the supervisor only).

Overview of specializations

Offered as: 1-professional Specialisation: Nanobiotechnology						
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Design and Engineering of Nano- and Microstructures (M-FT-K1-1N)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Advanced Gene Technology (M-NB-K1-2)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Reaction Engineering and Molecular Electronics (M-NB-K1-3)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Molecular Simulations (M-NB-K1-4)	Course	5	Passed/Not Passed	Internal examination	Active participation/continuous evaluation	English
2 SEMESTER						
Production and Characterization of Nano- and Microstructures (M-FT-K2-1N)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Self-Assembling Systems (F-NB-K2-2)	Course	5	Passed/Not Passed	Internal examination	Written or oral exam	English
NMR and MS (K-BT-B6-14A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English

Physics and Chemistry of Surfaces (F-FYS-K2-5A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Advanced Nanobiotechnology (M-NB-K3-2)	Project	20	Passed/Not Passed	Internal examination	Oral exam based on a project	English
Materials Chemistry (K-KEM-K1-20)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Materials Characterization (M-MN-K1-2A)	Course	5	Passed/Not Passed	Internal examination	Written or oral exam	English
3 SEMESTER Option B						
Advanced Nanobiotechnology (M-NB-K3-3)	Project	25	Passed/Not Passed	Internal examination	Oral exam based on a project	English
Elective courses on 3rd semester - Nanobiotechnology	Course	5				
3 SEMESTER Option C						
Advanced Nanobiotechnology (M-NB-K3-4)	Project	30	Passed/Not Passed	Internal examination	Oral exam based on a project	English
3 SEMESTER Option D						
Project-oriented Study in an External Organisation (M-NB-K3-5)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Option A						
Master’s Thesis (M-FT-K4-2)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English
Materials Characterization (M-MN-K1-2A)	Course	5	Passed/Not Passed	Internal examination	Written or oral exam	English
Materials Chemistry (K-KEM-K1-20)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3-4 SEMESTER Option B						
Master’s Thesis (M-FT-K4-3)	Project	60	7-point grading scale	External examination	Master's thesis/final project	English
4 SEMESTER						
Master’s Thesis (M-MN-K4-1A)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional

Specialisation: Nanomaterials and Nanophysics

Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						

Design and Engineering of Nano- and Microstructures (M-FT-K1-1N)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Materials Characterization (M-MN-K1-2A)	Course	5	Passed/Not Passed	Internal examination	Written or oral exam	English
Numerical Methods (M-MP-B5-3B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Semiconductors: Physics, Devices and Engineering (F-FYS-K3-9)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Production and Characterization of Nano- and Microstructures (M-FT-K2-1N)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Quantum materials and optical nanostructures (F-NFM-K2-3A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Selected Topics in Physics and Materials Science (M-FT-K2-2)	Course	5	Passed/Not Passed	Internal examination	Active participation/continuous evaluation	English
Physics and Chemistry of Surfaces (F-FYS-K2-5A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Materials engineering (M-MN-K3-1A)	Project	25	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective courses on 3rd Semester - Nanomaterials and Nanophysics	Course	5				
3 SEMESTER Option B						
Materials engineering (M-MN-K3-2A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3 SEMESTER Option C						
Project Oriented Study in an External Organisation (M-MN-K3-4)	Project	25	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective courses on 3rd Semester - Nanomaterials and Nanophysics	Course	5				
3 SEMESTER Option D						
Project Oriented Study in an External Organisation (M-MN-K3-3)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Option A						
Master’s Thesis (M-FT-K4-2)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English
Elective courses on 3rd Semester - Nanomaterials and Nanophysics	Course	10				

3-4 SEMESTER Option B						
Master's Thesis (M-FT-K4-3)	Project	60	7-point grading scale	External examination	Master's thesis/final project	English
4 SEMESTER						
Master's Thesis (M-MN-K4-1A)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Elective courses

Elective courses on 3rd semester - Nanobiotechnology						
Module name	Course type	ECTS	Applied grading scale	Evaluation Method	Assessment method	Language
Materials Chemistry (K-KEM-K1-20)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Materials Characterization (M-MN-K1-2A)	Course	5	Passed/Not Passed	Internal examination	Written or oral exam	English

Elective courses on 3rd Semester - Nanomaterials and Nanophysics						
Module name	Course type	ECTS	Applied grading scale	Evaluation Method	Assessment method	Language
Fracture Mechanics and Fatigue (M-DMS-K1-4)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Finite Element Methods (M-DMS-K1-5)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Solid State Physics II: Electronic Structure (F-FYS-K1-4)	Course	5	7-point grading scale	Internal examination	Oral exam	English

§ 19: ADDITIONAL INFORMATION

All students who have not participated in Aalborg University's PBL introductory course during their Bachelor's degree must attend the introductory course "Problem-based Learning and Project Management". The introductory course must be approved before the student can participate in the project exam. Please see further information about the course on the study board website https://www.mp.aau.dk/education/rules-and-regulations-eng-da.

The current version of the study curriculum is published on the Aalborg University website for study curricula.

Additional information about semester descriptions is available in Moodle. Moodle provides study-related information, i.e. course descriptions, course literature, timetables and information about activities and events.

§ 20: COMMENCEMENT AND TRANSITIONAL RULES

The curriculum is approved by the dean and enters into force as of September 1, 2023.

§ 21: AMENDMENTS TO THE CURRICULUM AND REGULATIONS

7 July 2023: The Vice-dean of education has approved that the module "Advanced Materials Science and Physical Metallurgy" will be replaced with "Numerical Methods" (1 semester, specialisation in Nanomaterials and Nanophysics) valid from autumn 2023.

7 July 2023: The Vice-dean of education has approved that the module "Computer Modelling" will be replaced with "Selected Topics in Physics and Material Science" (2 semester, specialisation in Nanomaterials and Nanophysics) valid from autumn 2023.

The Vice-dean has on November 24, 2023, approved an addition of Micro Modules in section 17, valid from spring 2024.