AALBORG UNIVERSITET

MASTER OF SCIENCE IN ENGINEERING (NANOBIOTECHNOLOGY), 2017

MASTER OF SCIENCE (MSC) IN ENGINEERING
AALBORG

MODULES INCLUDED IN THE CURRICULUM

TABLE OF CONTENTS

NANOBIOENGINEERING

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The project is designed to cover a broad range of topics. It can be a theoretical or an experimental project dealing with all aspects relevant for manufacturing and engineering of biological/organic nanostructures.

LEARNING OBJECTIVES

KNOWLEDGE

• must have knowledge about how to design, model and manufacture different biological/organic nanostructures
• must be able to understand the fundamental concepts of engineering and design of nanostructures based on organic/biological systems

SKILLS

• must be able to apply the design, engineering and manufacturing concepts in order to predict and fabricate the desired organic or bio-nanostructures
• must be able to evaluate the different methods used for production, design, and engineering of nanobiostructures

COMPETENCES

• must have obtained the skills to design, model, fabricate and characterize nano-scale (bio)structures

TYPE OF INSTRUCTION

Supervised project work done in groups.

EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Nanobioengineering
Type of exam	Oral exam based on a project
ECTS	15
Permitted aids	All written and all electronic aids
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Nanobioengineering
Module code	F-NB-K1-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Eva Maria Petersen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ADVANCED GENE TECHNOLOGY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the module Gene Technology on 5th semester of the Bachelor in Nanotechnology as well as knowledge in Organic Chemistry and Biochemistry.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

• Must have knowledge about advanced gene expression systems
• Must have knowledge about high throughput screening methods

• Must have knowledge about advanced applications of gene technology in the areas of biotechnology, medicine, and nanotechnology

SKILLS

• Must be able to apply the knowledge to solve real world problems
• Must be able to understand the principles

• Must be able to engineer (theoretically) new DNA based nano-devices

COMPETENCES

• Must have a deeper understanding of the principles and tools
• Must know how to engineer nano-devices for applications in the area of medicine and biotechnology

TYPE OF INSTRUCTION

Lectures with problems.

EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Gene Technology
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Avanceret genteknologi
Module code	F-NB-K1-2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Eva Maria Petersen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

REACTION ENGINEERING AND MOLECULAR ELECTRONICS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge in the area of Physical Chemistry, Inorganic and Organic Chemistry, Lab-on-a-Chip, Basic Quantum Mechanics, and Microbiology.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

• Must acquire knowledge about basic design principles and modeling of chemical, biochemical, and biotechnological reactors
• Must acquire knowledge about micro-reactors and their application in biotechnology

• Must acquire knowledge on the underlying principles and the current state of molecular electronics

SKILLS

• Must be able to apply the acquired knowledge to the design and performance evaluation of batch and continuous flow reactors
• Must be able to model chemical and biochemical reactors using COMSOL and other mathematical modeling software

COMPETENCES

• Must have working knowledge and basic skills for designing, modeling and evaluating of chemical, biochemical, and biotechnological reactors
• Must acquire an overview of the current progress in the area of molecular electronics

TYPE OF INSTRUCTION

Lectures and exercises.

EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Reaction Engineering and Molecular Electronics
Type of exam	Oral exam
ECTS	5

Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	Besides the evaluation criteria stated in the Joint Programme Regulations, the grade requires participation in presentations and discussions of research papers and completion of an assignment. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Engineering af reaktioner og molekylær elektronik
Module code	F-NB-K1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Leonid Gourevitch, Eva Maria Petersen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

MOLECULAR SIMULATIONS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained in the area of Organic Chemistry, Protein Physics, Basic Quantum Mechanics, and Physical Chemistry.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Students who complete the module: will have gained skills in the up to date computer modeling techniques of molecular dynamics and analysis of in silico modeled protein, peptide and membrane structures and function.

LEARNING OBJECTIVES

KNOWLEDGE

• Must have knowledge about modern force fields
• Must have knowledge about protein folding and function

• Must have knowledge about the general building blocks of proteins and their chemistry

• Must be able to evaluate protein structures

• Must be able to apply the principals of protein structures and functions to real problems

SKILLS

• Must be able to apply principals of Molecular dynamics simulations to real problems
• Must be able to evaluate modeled protein structures and function

• Must be able to apply the properties and chemistry of the aminoacids to real world problems

• Must be able to evaluate results from molecular dynamics simulations

COMPETENCES

• Must have a basic understanding of molecular modelling
• Must have a general understanding of the physics of protein dynamics and force field based modeling strategies

• Must have a general knowledge molecular simulations

TYPE OF INSTRUCTION

Lectures with accompanying problem solving session.

EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Molecular Simulations
Type of exam	Active participation/continuous evaluation
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Molekylær simulering
Module code	F-NB-K1-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

CHARACTERISATION OF NANOBIOSTRUCTURES

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB1 (1st semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The project is designed to cover a broad range of topics. It can be a rather more theoretical or experimental project dealing with all aspects relevant for manufacturing and characterization of biological/organic nanostructures.

LEARNING OBJECTIVES

KNOWLEDGE

• Must have knowledge about methods and tools used for production and characterization of biological/organic nanostructures
• Must be able to understand the fundamental concepts behind the methods and tools used for production and characterization of biological/organic nanostructures

SKILLS

• Must be able to produce biological/organic nanostructures and must be able to investigate their properties by using different methods and tools
• Must be able to evaluate the different methods used for production and characterization of nano(bio)structures

COMPETENCES

• Must have obtained the skills to produce and characterize biological/organic nanostructures by using different tools

TYPE OF INSTRUCTION

Supervised project work done in groups.

EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Characterisation of Nanobiostructures
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Karakterisering af nanobiostrukturer
Module code	F-NB-K2-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Eva Maria Petersen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

SELF-ASSEMBLING SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained in the area of Physical Chemistry, Inorganic and Organic Chemistry, and Biochemistry.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

• Must acquire knowledge about basic principles of self-assmbling behavior in nature, forces involved in the process, ways to model and design a self-assembling system
• Must acquire knowledge about application of self-assembly for drug-delivery, thin films and nano-arrays

SKILLS

• Must be able to use Langmuir-Blodgett technique as well as other methods to fabricate monolayers, micelles and vesicles
• Must be able to apply the acquired knowledge to critically read and understand research papers on the subject of self-assembly

COMPETENCES

• Must acquire an overview of the current progress in the areas of self-assembly and drug delivery

EXTENT AND EXPECTED WORKLOAD

Lectures and exercises.

EXAM

EXAMS

Name of exam	Self-Assembling Systems
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Selvorganiserende biostrukturer

Module code	F-NB-K2-2
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Leonid Gourevitch, Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

PHYSICS AND CHEMISTRY OF SURFACES

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module is built on knowledge obtained in the area of General and Physical Chemistry.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Aim of the course is to provide knowledge about specific aspects as well as physical and chemical phenomena occurring at surfaces and interfaces.

LEARNING OBJECTIVES

KNOWLEDGE

• Structure of crystalline surfaces as well as the methods and techniques for their preparation and characterisation;
• basic thermodynamics and kinetics of surface processes including phenomena of surface tension and adsorption/desorption;

• major interaction forces near the interfaces including van der Waals and double-layer forces;

• physi- and chemi-sorption at surfaces and catalysis;

• structure of interfaces, wetting theory, hydrophobicity, membranes and growth of thin films;

• reactions at interfaces and electrochemistry.

SKILLS

The student will become skilled in solving problems within the topics listed above and will be able to apply theories and methods of surface physics and chemistry.

COMPETENCES

Competencies that are acquired develop and strengthen the knowledge and understanding of theory and methods in surface science, as well as their applications. Based on the skills acquired in this module the student should be able to reflect on and discuss topics from surface science.

TYPE OF INSTRUCTION

Lectures supported by problem solving classes.

EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Physics and Chemistry of Surfaces
Type of exam	Oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Overfladefysik og -kemi (B)
Module code	F-FYS-K2-5
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Leonid Gurevitch, Vladimir Popok

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

NMR AND MS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained in the area of Organic and Physical Chemistry

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

NMR: The physical background for NMR:

- Nuclear spin, spin in a magnetic field, CW-NMR, FT-NMR, radiofrequency pulses
- Spectral parameters: chemical shift, scalar and dipolar coupling
- Spectroscopic technique: 1D experiments with one or more pulses
- Experimental aspects: construction of NMR spectrometer, experimental NMR, signal treatment, Nuclear Magnetic Relaxation: spin-lattice or spin-spin relaxation and their dependence on molecular mobility, nuclear Overhauser effect
- 2D-NMR: Meaning of 'chemical shift labeling', magnetization transfer between spins, acquisition of the indirect dimension, homonuclear 2D-NMR (COSY, TOCSY, NOESY), heteronuclear 2D-NMR (HSQC, HMQC)
- Dynamic NMR Spectroscopy: chemical shift, lineshape analysis, 'coalescence', timescale for NMR
- Interpretation of NMR spectra: assignment of signals, structure determination of small molecules
- Selected topics of modern, applied NMR, i.e. NMR of macromolecules, 'magnetic resonance imaging' description of NMR based on quantum mechanics, metabolic profiling via NMR
- Problems: Interpretation of spectra, identification of compounds based on their spectra, collecting data on the in-house spectrometer, theoretical calculations

MS:

- History of MS development and applications within biotechnology and chemistry
- Physical concept behind MS ionization (matrix-assisted laser desorption ionization/electro-spray)
- Mass analyzer (time-of flight, quadrupol, ion-field)
- MS/MS sequencing, iondetection, reflectron
- Application of on-line chromatography (HPLC, GC, CE)
- Special applications for different MS, i.e. MALDI-TOF-MS and nano-spray followed by MS/MS for analysis of proteins
- Interpretation of spectra of organic molecules (proteins, peptides and DNA sequences, carbohydrates) and problems to support the theory behind it.
- Introduction to mass spectrometry baed bioinformatics

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module

- Should have knowledge about the theoretical background of NMR and MS, especially about how to get signals and interpretation of signals
- should have knowledge about the experimental process how NMR and MS data are collected

SKILLS

- should be able to interpret 1D and 2D NMR spectra which means to be able to predict a spectrum from a given structure, find an unknown structure based on a given spectrum or be able to assign NMR signals to atoms within a structure
- should be able to evaluate applications for NMR and MS for chemical/biotechnological/nanotechnological problems
- should be able to interpret MALDI MS and ESI MS spectra
- should be able to use correct concept, nomenclature, and symbols from the NMR and MS literature

EXAM

EXAMS

Name of exam	NMR and MS
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	Are stated in the Joint Programme Regulations

FACTS ABOUT THE MODULE

Danish title	NMR og MS
Module code	K-BT-B6-14
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	Danish
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Reinhard Wimmer

ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

MASTER'S THESIS (30 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB3 (3rd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The project can cover the same topic as the 3rd semester project and should be approved by the Board of Studies.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures described in the thesis
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject of the thesis

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art within the area of the thesis subject

• Ability to define the limits of the project

• Ability to demonstrate scientific and professional project work

• Ability to reflect over the obtained results

COMPETENCES

• Applying the knowledge and skills obtained during the master program to solve the subject specific problem of the thesis with the support of the supervisor
• Evaluate the approach, methods, and materials used for the project to fulfill the goal of the project

• Be able to relate the problem to the relevant field/area and the obtained results

• Be able to make and justify decisions on the relevant theories and methods

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 30 ECTS project module and the work load is expected to be 900 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis (30 ECTS)
Type of exam	Oral exam based on a project
ECTS	30
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale (30 ECTS)
Module code	F-NB-K4-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ADVANCED NANOBIOTECHNOLOGY (15 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This project focuses on all kinds of advanced biostructures and their static and dynamic properties.

Different advanced nanobiostructures will be manufactured and/or modeled and their static and dynamic properties will be characterized using state-of-the-art scientific tools, techniques and theories.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art methods and principles used in the project

• Ability to define the limits of the project

• Ability to reflect over the obtained results

COMPETENCES

• should be able to identify, formulate, and analyze independently a problem
• should have the necessary skills to identify and apply the relevant scientific theories and methods to the formulated problem

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Nanobiotechnology (15 ECTS)
Type of exam	Oral exam based on a project

ECTS	15
Permitted aids	All written and all electronic aids
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Avanceret Nanobioteknologi (15 ECTS)
Module code	F-NB-K3-5
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ADVANCED NANOBIOTECHNOLOGY (20 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This project focuses on all kinds of advanced biostructures and their static and dynamic properties.

Different advanced nanobiostructures will be manufactured and/or modeled and their static and dynamic properties will be characterized using state-of-the-art scientific tools, techniques and theories.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art methods and principles used in the project

• Ability to define the limits of the project

• Ability to reflect over the obtained results

COMPETENCES

• should be able to identify, formulate, and analyze independently a problem
• should have the necessary skills to identify and apply the relevant scientific theories and methods to the formulated problem

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 20 ECTS project module and the work load is expected to be 600 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Nanobiotechnology (20 ECTS)

Type of exam	Oral exam based on a project
ECTS	20
Permitted aids	All written and all electronic aids
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Avanceret Nanobioteknologi (20 ECTS)
Module code	F-NB-K3-2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ADVANCED NANOBIOTECHNOLOGY (25 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This project focuses on all kinds of advanced biostructures and their static and dynamic properties.

Different advanced nanobiostructures will be manufactured and/or modeled and their static and dynamic properties will be characterized using state-of-the-art scientific tools, techniques and theories.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art methods and principles used in the project

• Ability to define the limits of the project

• Ability to reflect over the obtained results

COMPETENCES

• should be able to identify, formulate, and analyze independently a problem
• should have the necessary skills to identify and apply the relevant scientific theories and methods to the formulated problem

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 25 ECTS project module and the work load is expected to be 750 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Nanobiotechnology (25 ECTS)
Type of exam	Oral exam based on a project

ECTS	25
Permitted aids	All written and all electronic aids
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Avanceret Nanobioteknologi (25 ECTS)
Module code	F-NB-K3-4
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	25
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ADVANCED NANOBIOTECHNOLOGY (30 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This project focuses on all kinds of advanced biostructures and their static and dynamic properties.

Different advanced nanobiostructures will be manufactured and/or modeled and their static and dynamic properties will be characterized using state-of-the-art scientific tools, techniques and theories.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art methods and principles used in the project

• Ability to define the limits of the project

• Ability to reflect over the obtained results

COMPETENCES

• should be able to identify, formulate, and analyze independently a problem
• should have the necessary skills to identify and apply the relevant scientific theories and methods to the formulated problem

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 30 ECTS project module and the work load is expected to be 900 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Nanobiotechnology (30 ECTS)
Type of exam	Oral exam based on a project

ECTS	30
Permitted aids	All written and all electronic aids
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Avanceret Nanobioteknologi (30 ECTS)
Module code	F-NB-K3-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP (30 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge obtained on the 1st and 2nd semester of the master programme.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

• Discuss the subject matter of the project specified within the area of the study programme

SKILLS

• Solve complex problems using theory and concepts within physics
• Evaluate and choose among potentially relevant theories, concepts and methodologies applied to solve problem within physics.

• Evaluate the relevance and limitations of the theories, concepts, methods and tools actually applied in the project

• Account for any choices made during the problem analysis and solution development

• Develop solution alternatives and evaluate the consequences of solution alternatives and make a well-informed choice based on that

• Plan, execute and report an extensive individual research project within an agreed time frame

• Write a well-structured project report, which meets all the usual requirements of an academic work, including:

o Empirical background

o Research problem/project objective

o Relevant theory

o Research design:

o Presentation of data

o Presentation and discussion of findings

o Evaluation of the project; i.e., findings, methods and, if relevant, considerations regarding the limitations and generalizability of the study.

o specific for internship: a personal reflection is required, a reflection on: how was it to work alone, full-time in a company, and, if applicable, in a different country with a different culture, language, industrial structure, etc.

COMPETENCES

• Analyze and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental, and/or numerical methods and models
• Work together with an organization and identify problems and finally develop solutions

• Operationalize theoretical contributions in a practical setting

• Compare and critically evaluate the results of the project in relation to existing knowledge and accepted theories within the subject area

• Communicate a balanced view of the results and conclusions of the project in well-organized written and oral presentation

TYPE OF INSTRUCTION

The student is included in the company's daily work and carry out independent project work on an industrial problem relevant for the company. Concurrent to the work in the company, the student makes a project report, which is evaluated after the ending of the internship.

EXTENT AND EXPECTED WORKLOAD

This is a 30 ECTS project module and the work load is expected to be 900 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project
ECTS	30
Permitted aids	All written and all electronic aids
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed (30 ECTS)
Module code	F-FYS-K3-4
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	Danish and English

Location of the lecture	Campus Aalborg
Responsible for the module	Lars Diekhöner

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

SYNTHESIS AND CHARACTERISATION (COURSE MODULE)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge in the area of Electronic structures of solids and Nanofabrication.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

• Optical characterisation techniques
• Ellipsometry

• Photo luminescense

• Electron microscopy

• Electron beam writing

• Thin film deposition

• Reactive ion etching

• Fucused ion beam lithography

• Atomic force microscopy

SKILLS

• Apply basic experimental techniques for geometrical characterisation of nanostructures
• Synthesise and characterise thin film

• Produce surface structures using particle beam lithography

COMPETENCES

• Be able to design fabrication processes for nano-scale components
• Be able to produce simple components

• Be able to analyse results and compare to basic limitations

EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Synthesis and Characterisation (course module)
Type of exam	Active participation and/or written assignment Individual continuous evaluation based on exercises given through the course.
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Syntese og karakterisering (kursusmodul)
Module code	F-FYS-K3-8
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Buhl Sørensen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

TEST AND VALIDATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon knowledge obtained in the modules Applied Statistics and Probability Theory or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Understand methodology for design of experiments and test series and for reduction of ambiguity of experimental results, and for comparability with model predictions
- Explain elementary and advanced quantification tools, and their application to validation between model and experiment data
- Account for common contemporary methods and relevant specific industry standards
- Understand processing methods for analog and digital data (continuous vs. discrete)

SKILLS

- Scrutinize a non-trivial physical systems for appropriate experimental study
- Isolate principal measurable parameters
- Design an experiment matrix for systematic variation of parameters
- Perform a probabilistic study of the experimental data in order to quantify the influence of individual parameters
- Scrutinize a model (analytical or numerical) for comparison with an appropriate experimental study
- Isolate principal input parameters and their known or assumed statistical variations
- Perform a probabilistic study of the model in order to quantify the level of confidence
- Account for the level of coherence between test results and model predictions
- Identify invalid data (outliers)
- Account for common errors and limitations in the processing of model data or experimentally obtained data

COMPETENCES

- Undertake experiment planning and execution for refinement and validation (or rejection) of model-based predictions of phenomena within their principal line of study

TYPE OF INSTRUCTION

The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Test and Validation
Type of exam	Written and oral exam Oral examination based on a submitted written assignment.

ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Test og validering
Module code	N-EE-K3-21
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg
Responsible for the module	Erik Appel Jensen, Henrik Sørensen

ORGANISATION

Study Board	Study Board of Energy
Department	Department of Energy Technology
Faculty	Faculty of Engineering and Science

MATERIALS CHEMISTRY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Inorganic Chemistry and Physical Chemistry

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The purposes of the course are to introduce both fundamental chemical principles of materials and nano-materials, and main methods for developing, optimizing, post-treating and characterizing materials regarding different physical and chemical performances.

The focus will be placed on the relation between chemical composition, structure and properties. The course will introduce the current status of materials and nano-materials technologies.

Materials chemistry focuses on the fundamental principles and applications of both conventional and advanced inorganic materials. The course is divided into the following two parts.

1. General inorganic materials chemistry and characterization of inorganic materials (e.g., glass chemistry, ceramic chemistry, metal chemistry, cement industry)
2. Chemistry of organic and inorganic nano-materials (e.g., thin films, nano-crystals and –particles, nanotubes, mesoporous materials, nano wires, etc.).

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Understand the fundamental principles of materials chemistry and how it relates to practical use
- Explain different application areas of materials and ways to optimize the production process of materials

SKILLS

- Prepare, synthesize and modify materials to reach target properties using theoretical and practical knowledge in materials chemistry
- Design, synthesize, and produce nanostructured materials with given properties.
- Characterize conventional materials and nano-materials

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Materials Chemistry
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale

Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

FACTS ABOUT THE MODULE

Danish title	Materialekemi
Module code	K-KEM-K1-20
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Yuanzheng Yue, Morten Mattrup Smedskjær

ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

MASTER'S THESIS (45 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student has the possibility to write a Long Master's Thesis (over 2 semesters), if the thesis is of experimental character. A Long Master's Thesis can be chosen as either 45, 50, or 60 ECTS. If choosing to do a Long Master's Thesis, the amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures described in the thesis
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject of the thesis

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art within the area of the thesis subject

• Ability to define the limits of the project

• Ability to demonstrate scientific and professional project work

• Ability to reflect over the obtained results

COMPETENCES

• Applying the knowledge and skills obtained during the master program to solve the subject specific problem of the thesis with the support of the supervisor
• Evaluate the approach, methods, and materials used for the project to fulfill the goal of the project

• Be able to relate the problem to the relevant field/area and the obtained results

• Be able to make and justify decisions on the relevant theories and methods

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 45 ECTS project module and the work load is expected to be 1350 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis (45 ECTS)
Type of exam	Oral exam based on a project
ECTS	45
Permitted aids	All written and all electronic aids
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale (45 ECTS)
Module code	F-NB-K3-7
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	45
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

MASTER'S THESIS (50 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student has the possibility to write a Long Master's Thesis (over 2 semesters), if the thesis is of experimental character. A Long Master's Thesis can be chosen as either 45, 50, or 60 ECTS. If choosing to do a Long Master's Thesis, the amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures described in the thesis
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject of the thesis

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art within the area of the thesis subject

• Ability to define the limits of the project

• Ability to demonstrate scientific and professional project work

• Ability to reflect over the obtained results

COMPETENCES

• Applying the knowledge and skills obtained during the master program to solve the subject specific problem of the thesis with the support of the supervisor
• Evaluate the approach, methods, and materials used for the project to fulfill the goal of the project

• Be able to relate the problem to the relevant field/area and the obtained results

• Be able to make and justify decisions on the relevant theories and methods

TYPE OF INSTRUCTION

Projekct work.

EXTENT AND EXPECTED WORKLOAD

This is a 50 ECTS project module and the work load is expected to be 1500 hours for the student

EXAM

EXAMS

Name of exam	Master's Thesis (50 ECTS)
Type of exam	Oral exam based on a project
ECTS	50
Permitted aids	All written and all electronic aids
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale (50 ECTS)
Module code	F-NB-K3-6
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	50
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

MASTER'S THESIS (60 ECTS)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the project on NB2 (2nd semester)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student has the possibility to write a Long Master's Thesis (over 2 semesters), if the thesis is of experimental character. A Long Master's Thesis can be chosen as either 45, 50, or 60 ECTS. If choosing to do a Long Master's Thesis, the amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

• Knowledge of the subject-specific methods as well as tools applied for the design, fabrication, characterization, and modeling of the biological and organic nanostructures described in the thesis
• Knowledge of the biological, physical, and (bio)chemical principles behind the subject of the thesis

SKILLS

• Ability to approach, describe, and solve a specific problem using the tools available
• Ability to explore and achieve sufficient understanding of the state-of-the-art within the area of the thesis subject

• Ability to define the limits of the project

• Ability to demonstrate scientific and professional project work

• Ability to reflect over the obtained results

COMPETENCES

• Applying the knowledge and skills obtained during the master program to solve the subject specific problem of the thesis with the support of the supervisor
• Evaluate the approach, methods, and materials used for the project to fulfill the goal of the project

• Be able to relate the problem to the relevant field/area and the obtained results

• Be able to make and justify decisions on the relevant theories and methods

TYPE OF INSTRUCTION

Project work.

EXTENT AND EXPECTED WORKLOAD

This is a 60 ECTS project module and the work load is expected to be 1800 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis (60 ECTS)
Type of exam	Oral exam based on a project
ECTS	60
Permitted aids	All written and all electronic aids
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale (60 ECTS)
Module code	F-NB-K3-3
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	60
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Fojan

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science