



AALBORG UNIVERSITET

# **CIVILINGENIØR, CAND.POLYT. I KEMI 2020**

CIVILINGENIØR  
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

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# MATERIALS TECHNOLOGY

2020/2021

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The aim is to solve material technological problems in connection to industrial production and development

Projects will deal with industrial problems where knowledge in materials chemistry and unit operations will be applied for the understanding and solving the problem. Projects cover materials preparation, synthesis, characterization, development, post-treatment and application. Projects should be related to optimization of materials processing or development of new materials.

Objects of materials are mainly inorganic materials such as ceramics, glasses, cements, composites, refractory materials, thin films, inorganic nano-materials and hybrid-materials.

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- account for inorganic materials chemistry, synthesis and materials forming process
- clarify the relationships among production process, materials selection, microstructure and material properties within the selected project
- demonstrate insight in unit operations with respect to processing of materials for the selected problem/project

### SKILLS

- write a project report following the standards of the field of study, include relevant original scientific literature, use the correct terminology, and communicate the research-based foundation and problem and results in writing, graphically and orally in a professionally reasoned and coherent way
- assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess the problem of the project and results in relevant scientific contexts and social conditions

### COMPETENCES

- handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement academic assignments and interdisciplinary collaborations
- take responsibility for own professional development and specialization

### TYPE OF INSTRUCTION

- Project work

## EXAM

### EXAMS

Name of exam	Materials Technology
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures
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## FACTS ABOUT THE MODULE

Danish title	Materialeteknologi
Module code	K-KEM-K1-48A
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	<a href="#">Yuanzheng Yue</a>

## ORGANISATION

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

# MATERIALS CHEMISTRY

**2020/2021**

## 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

- explain 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

### TYPE OF INSTRUCTION

- Lectures
- Workshops
- Exercises (individually and in groups)

### 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	The criteria of assessment are stated in the Examination Policies and Procedures

## 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	<a href="#">Yuanzheng Yue</a> , <a href="#">Morten Mattrup Smedskjær</a>

## ORGANISATION

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

# PROCESSING OF MATERIALS

**2020/2021**

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Materials Chemistry, Unit Operations, Modelling of heterogeneous processes

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The purpose is to introduce students to knowledge about materials manufacturing, post-treatment and the impact of the manufacture conditions on the structure and properties of materials. To introduce students to the analysis of large-scale industrial systems as well as methods and principles of environmental evaluation. To enable students in chemical engineering to collaborate with mechanical engineers

The courses cover the introduction to e.g.:

- Application areas and development tendencies of plastics
- Chemical performances of materials
- Manufacturing technology of polymers
- Manufacturing technology of ceramics, cements and glasses
- Environmental analysis and management
- Industrial processes by visiting relevant industries

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- clarify the relationship among chemical composition, structure, properties and manufacturing

### SKILLS

- conduct calculations of manufacture parameters and mechanical, physical and chemical properties
- apply materials manufacturing technologies and their engineering applications
- predict certain properties of materials based on their manufacturing parameters
- design manufacturing and post-treatment processes that can improve physical and chemical performances of materials
- carry out analysis of large-scale production processes

## TYPE OF INSTRUCTION

- Lectures
- Workshops
- Exercises (individually and in groups)

## EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Processing of Materials
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Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Materialeforarbejdning
Module code	K-KEM-K1-19
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	<a href="#">Yuanzheng Yue</a> , <a href="#">Morten Mattrup Smedskjær</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
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# PHYSICAL CHEMISTRY OF MATERIALS

2020/2021

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to knowledge obtained in Physical Chemistry and Analytical Chemistry

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

- Materials thermodynamics
- Chemical reaction kinetics and dynamics in materials
- Phase equilibrium in materials
- Order and disorder in solid
- Experimental methods for collecting thermodynamic and kinetic data of materials, e.g., viscometric and calorimetric methods
- General electrochemistry
- Analytical electrochemistry
- Application of electrochemistry in materials science
- Description of electron-ion conductor junction as electrochemical electrode
- Electrolytes and their properties, redox reactions, conductivity and determination
- Links between electrochemical potentials, thermodynamic parameters and concentrations
- Electrochemical methods: Impedance spectroscopy, voltammetry, and other analytical methods and its instrumentation
- Type of electrodes, electrode kinetics and electrode related effects
- Description of the different type of batteries, accumulators and fuel cells

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- understand and apply the link between electrochemistry and thermodynamics
- explain and utilize phase diagram of materials
- clarify mechanisms behind the phase transitions

### SKILLS

- solve physical chemical problems in the fields of materials science and chemical processes
- collect and evaluate physical-chemical data by doing experiments such as the viscometric and calorimetric measurements
- apply different types of electron-ion conductor junction to understand their electrodynamic, thermodynamic and kinetic backgrounds
- apply different analytical methods based on electrochemical reactions
- apply the knowledge about chemistry, technology and economy of electrochemical processes in materials industry
- design the processes in batteries, accumulators and fuel cells

### COMPETENCES

- design experimental routes for synthesis and treatment of new materials based on physical chemistry and electrochemical principles

### TYPE OF INSTRUCTION

- Lectures
- Workshops
- Exercises (individually and in groups)

## EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Physical Chemistry of Materials
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Materialers fysiske kemi
Module code	K-KEM-K1-21
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	<a href="#">Yuanzheng Yue</a> , <a href="#">Jens Muff</a>

## ORGANISATION

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

# INDUSTRIAL APPLICATION OF MACROMOLECULES

2020/2021

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Organic Chemistry, Physical Chemistry, Unit Operations

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The purpose of the project is to give the students an extensive knowledge and competences in molecular applications of natural and synthetic macromolecules, principles of their production and characterisation of polymers from molecular architecture to properties in relation to their industrial use.

Projects will deal with industrial problems related to the chemistry and application of macromolecules. Projects could cover macromolecule synthesis, modification and/or characterization as well as applications of macromolecules.

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- Understand and account for the chemical properties of selected natural and synthetic macromolecules on molecular and macroscopic level
- Relate the chemical properties to the production of natural and synthetic macromolecules

### SKILLS

- write a project report following the standards of the field of study, include relevant original scientific literature, use the correct terminology, and communicate the research-based foundation and problem and results in writing, graphically and orally in a professionally reasoned and coherent way
- assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess the problem of the project and results in relevant scientific contexts and social conditions

### COMPETENCES

- handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement academic assignments and interdisciplinary collaborations
- take responsibility for own professional development and specialization

### TYPE OF INSTRUCTION

- Lectures
- Workshops
- Exercises (individually and in groups)

### EXTENT AND EXPECTED WORKLOAD

450 hours

## EXAM

### PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- An approved PBL competency profile is a prerequisite for participation in the project exam

### EXAMS

Name of exam	Industrial Application of Macromolecules
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

### FACTS ABOUT THE MODULE

Danish title	Industriell anvendelse af makromolekyler
Module code	K-KEM-K2-48A
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	<a href="#">Donghong Yu</a>
Time allocation for external examiners	B

### ORGANISATION

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

# POLYMER CHEMISTRY

2020/2021

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Fundamental Organic Chemistry, Experimental Organic Chemistry

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

To introduce the students majoring in chemistry or engineering a broad knowledge of polymer chemistry, such as principles of polymerization, polymer morphologies, polymer properties and so on. Meanwhile, some basic experimental techniques will be included in the lab course.

- Basic Principles: Molecular weight and polymer solutions
- Chemical Structure and Polymer Properties
- Polymer Morphology
- Step-reaction and ring opening polymerization and its lab course
- Free radical polymerization and its lab course
- Ionic Polymerization and its lab course
- Vinyl polymerization with complex coordination catalysts
- Characterization of polymers, Polyethers, -sulfides, and related polymers, Polyamides and related polymers. Heterocyclic polymers. Miscellaneous organic polymers, Inorganic and partially inorganic polymers. Natural Polymers.
- Recent developments in the frontier research for novel polymerization technique of new materials
- Basic experimental techniques will be included in laboratory exercises

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- Account for different categories of polymers and their use in selected applications
- Characterize and categorize polymers
- Explain different polymerization and modification principles

### SKILLS

- Design synthetic routes of functional monomers
- Perform polymerization under various conditions
- Modify polymer surfaces

### COMPETENCES

- Characterize macromolecules: from chemical structure to molecular weights and distributions

## TYPE OF INSTRUCTION

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
- Workshop exercises (individually and in groups)
- Project work and exercises in labs
- Teacher feedback

## EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Polymer Chemistry
Type of exam	Written exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Polymerkemi
Module code	K-KEM-K2-19
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	<a href="#">Donghong Yu</a>
Time allocation for external examiners	F

## ORGANISATION

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

# SUPRAMOLECULAR CHEMISTRY

**2020/2021**

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

To introduce the students to supramolecular chemistry with focus on the physical chemistry of molecular interactions.

The course includes lectures and theoretical assignments, including

- The basic concepts of supramolecular chemistry
- Intermolecular forces and equilibrium considerations
- Thermodynamics and solvent effects
- Cation-and anion-specific ligands
- The supramolecular chemistry of biological systems
- The self-organization of molecules
- Self-assembly of macromolecules and polymers
- Experimental assessment and computational modelling of molecular interactions

## LEARNING OBJECTIVES

### KNOWLEDGE

Students who have passed the module should be able to

- Explain the principles of design of artificial ligands
- Relate similarities and differences of intra- and intermolecular forces of large molecules and aggregates
- Describe the thermodynamics of molecular interactions and account for the importance of solvents and additives on the strength of molecular interactions

### SKILLS

- Apply theories and methods for analysis of molecular interactions
- Apply experimental and computational models in the study of molecular interactions

### COMPETENCES

- Predict the molecular interactions of macromolecules and their implications on macroscopic behaviour

## TYPE OF INSTRUCTION

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
- Workshop exercises (individually and in groups)
- Project work and exercises in labs
- Teacher feedback

## EXTENT AND EXPECTED WORKLOAD

150 timer

## EXAM

### EXAMS

Name of exam	Supramolecular Chemistry
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

### FACTS ABOUT THE MODULE

Danish title	Supramolekylær kemi
Module code	K-KEM-K2-22
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	<a href="#">Kim Lambertsen Larsen</a>
Time allocation for external examiners	F

### ORGANISATION

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



# CARBOHYDRATE CHEMISTRY

2020/2021

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain and show in depth understanding of the structure and chemical properties of mono- and disaccharides as well as oligo- and polysaccharides
- Demonstrate knowledge of industrially important carbohydrates including hydrocolloids and their gelation properties
- Explain essential aspects of glycobiology
- Demonstrate in depth knowledge of the substrate specificity, regio- and anomeric selectivity as well as the function and catalytic mechanisms of carbohydrate active enzymes
- Demonstrate knowledge of the enzymology related to degradation and modification of plant based biomass including starch, cellulose and pectin

#### SKILLS

- Apply and suggest methods of carbohydrate synthesis and modifications to solve problems in industrial processes and applications
- Apply knowledge to evaluate structure in relation to functional properties of carbohydrates
- Carry out calculations on basic carbohydrate chemical concepts
- Perform theoretical analyses of chemical and physical methods in carbohydrate chemistry
- Suggest relevant chemical and enzyme catalysts for chemical reactions in carbohydrate chemistry

#### TYPE OF INSTRUCTION

- Lectures
- Theoretical exercises

#### EXTENT AND EXPECTED WORKLOAD

150 hours

### EXAM

#### EXAMS

Name of exam	Carbohydrate Chemistry
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Kulhydratkemi
Module code	K-BT-K2-9
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	<a href="#">Lars Haastrup Pedersen</a> , <a href="#">Kim Lambertsen Larsen</a>

## ORGANISATION

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

# PROJECT-ORIENTED STUDY IN AN EXTERNAL ORGANISATION

**2020/2021**

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain the scientific basis of the work carried out by the external organisation

#### SKILLS

- Master the scientific methods and general skills related to the project work in the external organisation
- Write a report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, and communicate and discuss the project's foundation, problem and results in writing, graphically and verbally in a coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess and discuss the problem of the project and results in relevant scientific contexts and social conditions
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other socially relevant factors

#### COMPETENCES

- Participate in development, innovation, and research and use scientific methods to solve complex tasks
- Take professional responsibility to implement independent assignments and interdisciplinary collaborations
- Independently take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work, supervised by an external supervisor in collaboration with an internal supervisor at Aalborg University
- Project work in an external organisation must be in areas of relevance to the competence profile of the program

#### EXTENT AND EXPECTED WORKLOAD

900 hours

## EXAM

### EXAMS

Name of exam	Project-Oriented Study in an External Organisation
Type of exam	Oral exam based on a project
ECTS	30
Assessment	Passed/Not Passed
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en ekstern organisation
Module code	K-KEM-K3-64
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	<a href="#">Kim Lambertsen Larsen</a>
Time allocation for external examiners	B

## 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

2020/2021

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- explain the scientific basis and scientific issues in within the competence profile of the program
- explain the highest international research within the thesis subject area

#### SKILLS

- master the scientific methods and general skills related to the competence profile of the program
- write a project report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, and communicate and discuss the project's research-based foundation and problem and results in writing, graphically and verbally in a professionally reasoned and coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and asses and discuss the problem of the project and results in relevant scientific contexts and social conditions
- evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other societal relevant factors

#### COMPETENCES

- participate in and independently implement technological and scientific development and research, develop and implement experimental work and solve complex tasks using scientific methods
- handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement independent academic assignments and interdisciplinary collaborations
- independently take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

Project work

#### EXTENT AND EXPECTED WORKLOAD

900 hours

## EXAM

### EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	30
Assessment	7-point grading scale
Type of grading	External examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures
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## FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	K-KMB-K4-5
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Responsible for the module	<a href="#">Lars Haastrup Pedersen</a>
Time allocation for external examiners	D

## 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

## 2020/2021

### CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

#### LEARNING OBJECTIVES

##### KNOWLEDGE

Students who have passed the module should be able to

- explain the scientific basis and scientific issues in within the competence profile of the program
- explain the highest international research within the thesis subject area

##### SKILLS

- master the scientific methods and general skills related to the competence profile of the program
- write a project report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, and communicate and discuss the
- project's research-based foundation and problem and results in writing, graphically and verbally in a professionally reasoned and coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and asses and discuss the problem of the project and results in relevant scientific contexts and social conditions
- evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other societal relevant factors

##### COMPETENCES

- participate in and independently implement technological and scientific development and research, develop and implement experimental work and solve complex tasks using scientific methods
- handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement independent academic assignments and interdisciplinary collaborations
- independently take responsibility for own professional development and specialization

##### TYPE OF INSTRUCTION

- Project work.

A long Master's thesis of more than 30 ECTS must include work of experimental nature and has to be approved by the Head of Studies. The amount of experimental work must reflect the allotted ECTS.

##### EXTENT AND EXPECTED WORKLOAD

1800 hours

### EXAM

#### EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	60

Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

## FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	K-KMB-K4-4
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	60
Language of instruction	English
Responsible for the module	<a href="#">Lars Haastrup Pedersen</a>
Time allocation for external examiners	D

## ORGANISATION

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