The Faculty of Engineering and Science
The Study Board for Industry and Global Business Development

AALBORG UNIVERSITY
DENMARK

Curriculum for Master's Programme in Materials Technology
(Cand.polyt.)

Aalborg University
September 2017

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dekan

Campus Aalborg

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Preface
Pursuant to Act 261 of March 18, 2015 on Universities (the University Act) with subsequent changes, the following curriculum for the Master's programme in Materials Technology is stipulated. The programme also follows the Joint Programme Regulations and the Examination Policies and Procedures for the Faculties of Engineering and Science, The Technical Faculty of IT and Design, and The Faculty of Medicine.

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Chapter 1: Legal Basis of the Curriculum, etc.

1.1 Basis in Ministerial Orders
The Master's programme in Materials Technology is organised in accordance with the Ministry of Higher Education and Science's Order no. 1328 of November 15, 2016 on Bachelor's and Master's Programmes at Universities (the Ministerial Order of the Study Programmes) and Ministerial Order no. 1062 of June 30, 2016 on University Examinations (the Examination Order). Further reference is made to Ministerial Order no. 111 of January 30, 2017 (the Admission Order) and Ministerial Order no. 114 of February 3, 2015 (the Grading Scale Order) with subsequent changes.

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

1.3 Board of Studies affiliation
The Master's programme falls under the Board of Studies for Industry and Global Business Development in the School of Engineering and Science.

1.4 Body of External Examiners
The Master's programme falls under the Body of External Examiners for Engineers (Ingeniørernes landsdækkende censorkorps (Maskin)).

Chapter 2: Admission, Degree Designation, Programme Duration and Competence Profile

2.1 Admission

Applicants with a legal right of admission (retskrav):

- Aalborg University offers no bachelor's programmes with a legal right of admission to this Master's program

Applicants without legal right of admission:
Applicants with the following bachelor's degree are entitled to admission:

- Bachelor of Engineering in Mechanical Engineering and Manufacturing, Aalborg University
- Bachelor of Science (BSc) in Engineering (Nanotechnology with specialisation in Physics), Aalborg University
- Bachelor of Science (BSc) in Physics, Aalborg University
- Bachelor of Science (BSc) in Chemistry, Aalborg University
- Bachelor of Engineering in Mechanical Engineering and Industry, Aalborg University
- Bachelor of Engineering in Nanotechnology, Aalborg University

Students with another Bachelor's degree may, upon application to the Board of Studies, be admitted following a specific academic assessment if the applicant is considered as having comparable educational prerequisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree designation in Danish and English
The Master's programme entitles the graduate to the Danish designation Civilingeniør, cand.polyt. i materialeteknologi. The English designation is: Master of Science (MSc) in Engineering (Materials Technology).

2.3 The programme's specification 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.

2.4 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 on the basis of 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.

2.5 Competence profile of the programme

<u>The graduate of the Master's programme:</u>

Knowledge	• Has attained thorough understanding of a broad range of theoretical and experimental techniques within the area of Materials Technology. • Has knowledge in several subject areas based on the highest international research level, within the field of materials technology. • Can understand and, on a scientific basis, reflect over subject area's related to materials technology and identify scientific problems within that area. • 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.
Skills	• Be able to apply scientific methodology to solve a wide variety of problems within the field of specialization. • Be able to perform scientific work in relevant topics of the field of specialization. • Be able to apply a wide range of engineering methods in research and development projects in the field of specialization. • Be able to participate in or lead projects in materials technology, materials selection, product development, and production technology. • Can communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists. • Can use advanced laboratory equipment test set ups and data collection methods.
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 within the area of materials technology.
- Be able to analyse and evaluate the influence of material structure and processing method on the material properties.
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility.
- Be able to direct the technical management of development projects within the industry.
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge.
- Can independently take responsibility for own professional development and specialization.

Chapter 3: Content and Organization of the Programme

The Master's programme in Materials Technology 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 graduates are expected to have gained a broad knowledge within the areas of Materials Technology. The graduates have knowledge about qualified materials selection, materials behavior to external stimuli, influence of processing on material properties and material microstructure, metallurgy, issues related to polymer chemistry, various material testing methods and simulation of material behavior.

The programme is structured in modules and organized as a problem-based study. A module is a programme element or a group of programme 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 programme 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

The third semester offers different ways of organisation – depending on the student's choice of content; project work at Aalborg University, study visit at an educational institution in Denmark or abroad, academic internship with project work at a company in Denmark or abroad, or a semester programme that comprises cross-disciplinary programme elements composed by the student. The total work load of the semester has to be equivalent to 30 ECTS, of which up to 15 ECTS can be elective courses. The project may be finalized with a project report or in the form of a scientific paper, or, if the project is continued at the 4th semester, with a midterm evaluation. For further information about the organisation of the module please see the Joint programme regulations, chapter 2.3.

At the 4th semester, the master thesis is completed. The master thesis can be combined with the 3rd semester in an extended master thesis.

3.1 Programme overview

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).

Semester		Module	ECTS	Grading	Exam
1.		Metallic Materials	15	7-point scale	External
		Metals and Alloys	5	7-point scale	Internal
		Continuum Mechanics	5[1]	7-point scale	Internal
		Solid Mechanics with Microstructure	5[1]	7-point scale	Internal
		Fracture Mechanics and Fatigue	5	7-point scale	Internal
2.		Polymers and Polymer Composites	15	7-point scale	External
		Fundamental Polymer Chemistry	5[2]	7-point scale	Internal
		Simulation and Measuring of Materials Behaviour	5	Passed/failed	Internal
		Polymers and Composite Materials	5	Passed/failed	Internal
		Polymer Chemistry	5[2]	7-point scale	Internal
3.	A	Industrial Development	30	7-point scale	Internal
	B	Academic Internship[3]	30	7-point scale	Internal
4.		Master's Thesis[4]	30, possible 60	7-point scale	External

The students are given options in the project modules as they can select among different projects within the same general theme. Moreover, the projects on the 3rd and 4th semester can be selected freely within the field of Materials Technology, and the students have the choice of making a long master's thesis comprising both semesters.

[1] Students with a Bachelor of Engineering in Mechanical Engineering and Manufacturing, Aalborg University follows the course Solid Mechanics with Microstructures, the rest follows the course Continuum Mechanics
[2] Students with a Bachelor of Science (BSc) in Chemistry follows the course Polymer Chemistry, the rest follows Fundamental Polymer Chemistry.
[3] The academic internship has to be approved by the study board before the beginning of the semester.
[4] The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board.

3.2 Materials Technology, 1st Semester

3.2.0 Problem Based Learning and Project Management

Title:
Problem Based Learning and Project Management
(Problembaseret læring og projektledelse)

Prerequisites:
None, but the course is compulsory for students not acquainted to the Aalborg PBL model

Objective:
The objective is to make newly started Master students coming from institutions other than AAU prepared to enter the problem based learning environment at AAU and manage study projects in close collaboration with peers.

Type of instruction:
Three half day workshops centered around the individual student working with an individual challenge or curiosity in relation to using a PBL approach. Peer learning is also a hallmark, since the students will discuss and reflect their individual challenges/curiosities in a peer learning group.

Learning outcomes: After completion of the course the student should be able to

Day 1:
- describe and discuss the Aalborg PBL model based on the three key words: group work, project work, problem orientation
- identify an initial individual challenge when using a PBL approach

Day2:
- develop and practice peer feedback skills
- practice collaborative learning in a group
- design a plan of action to deal with an initial individual PBL challenge or curiosity

Day 3:
- practice presentation skills
- practice critical skills when giving feedback to peers
- reflect on own and peer skills in relation to PBL practice

Form of examination:
Internal assessment during the course/class participation according to the rules in the Examination Policies and Procedures of Faculty of Engineering and Science, The Technical Faculty of IT and Design, and The Faculty of Medicine, Aalborg University. In this case the assessment is primarily based on the oral performance during the course, which means that the student has to be active during the course time and participate in discussions. The course is an integrated part of the project for those not acquainted to the Aalborg PBL model, and is a precondition for participation in the project examination. In this way there will be no diploma for the course and it will not be visible on the academic transcripts.

Evaluation criteria:
As stated in the Joint Programme Regulations

3.2.1 Metallic Materials

Title: **Metallic Materials (15 ECTS)**
(Metalliske materialer)

Aim: Students who complete the module are expected to:

Knowledge

- Have gained an in-depth understanding of theoretical and experimental methods in metallurgy within the specific area of topics covered by the project.
- Have attained an understanding for methods of analysis and experimental methods and their characteristics, applications, and limitations.

Skills

- Be able to describe and experimentally determine a likely phase and chemical composition for metallic alloys.
- Be able to demonstrate understanding of microstructure for metals and metal alloys.
- Be able to devise mechanical or heat treatments for a metal or an alloy, and be able to predict the outcome of applying such a treatment.
- Be able to give a critical evaluation of the methods applied for determining microstructure, chemical composition or mechanical and other properties.
- Be able to use correct terminology.
- Be able to compare theoretical and experimental results.

Competences

- Be able to set up a realistic hypothesis for the outcome of a process, obtaining a property or the like, within the field of metallurgy.
- Be able to devise an experimental method to falsify or validate a given hypothesis.
- Be able to use advanced experimental techniques within the field of metallurgy.
- Be able to apply the background theory and the insight obtained, in validation of material choice for a given application.

Form of instruction: The module is carried out as group-based problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organize and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: External, oral examination

Evaluation criteria: As stated in the Joint Programme Regulations

3.2.2 Metals and Alloys

Title: **Metals and Alloys (5 ECTS)**
(Metaller og legeringer)

Aim: Students who complete the module are expected to:

Knowledge

- Be able to understand the fundamental chemical, physical and microstructural description of metals and alloys.
- Be able to understand the relation between microstructure and mechanical properties.

Skills

- Be able to describe and predict microstructures and microstructural changes for heat treatments and mechanical treatments.
- Be able to connect processing parameters to mechanical properties.
- Be able to understand different kinds of corrosion mechanisms, and their prevention.
- Be able to use concepts of electrochemistry in problems pertaining to corrosion and electro deposition.

Competences

- Be able to understand and apply knowledge and theory in choosing materials and specifying relevant mechanical, heat,and surface treatments for a given application.
- Be able to take environment, loading conditions, and other relevant consideration into account in choosing materials and treatments.
- Be able to understand and apply knowledge and theory in developing materials with specific mechanical, physical and chemical properties.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral exam based on written reports.

Evaluation criteria: As stated in the Joint Programme Regulations

3.2.3 Continuum Mechanics

Title: **Continuum Mechanics (5 ECTS)**
(Kontinuummekanik)

Aim: Students who complete the module are expected to:

Knowledge

- Be able to understand central concepts, theories and methods in the theory of elasticity.
- Be able to describe spatial deformations with the use of theory of elasticity such that the geometrical, dynamical/statical and constitutive conditions are satisfied
- Be able to understand the concepts of non-linear elasticity, viscoelasticity and plasticity.

Skills

- Be able to account for the considerations necessary for applying the concepts, theories and methods of the theory of elasticity.
- Be able to use correct concepts, notation and symbols.
- Be able to use index notation and tensors in problems related to the theory of elasticity.

Competences

- Be able to use the theory of elasticity for determining displacements, strains, and stresses under different loading situations.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, oral examination.

Evaluation criteria: As stated in the Joint Programme Regulations

3.2.4 Solid Mechanics with Microstructure

Title: **Solid Mechanics with Microstructure (5 ECTS)**
(Kontinuummekanik og mikromekanik)

Aim: Students who complete the module are expected to:

Knowledge

- Be able to understand central concepts, theories and methods in the theory of elasticity.
- Be able to describe spatial deformations with the use of theory of elasticity such that the geometrical, dynamical/statical and constitutive conditions are satisfied
- Be able to understand the concepts of non-linear elasticity, viscoelasticity and plasticity.

Skills

- Be able to account for the considerations necessary for applying the concepts, theories and methods of the theory of elasticity.
- Be able to use correct concepts, notation and symbols.
- Be able to use index notation and tensors in problems related to the theory of elasticity.
- Be able to understand fundamental results pertaining to thermal stresses, inclusions, inhomogeneities, and dislocations.

Competences

- Be able to use the theory of elasticity for determining displacements, strains, and stresses under different loading situations.
- Be able to use results from elasticity theory in explaining material related problems on macro and micro structural levels.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, oral examination.

Evaluation criteria: As stated in the Joint Programme Regulations

3.2.5 Fracture Mechanics and Fatigue

Title: **Fracture Mechanics and Fatigue (5 ECTS)**
(Brudmekanik og udmattelse)

Aim: Students who complete the module are expected to:

Knowledge

- Have gained a comprehensive understanding of fracture mechanics.
- Have gained knowledge in applying classical methods in designing against fatigue fracture by studying notches and their effect, by studying strain-fatigue, and by analysing eigen-stress states.
- Have gained an understanding of how to apply fracture mechanics in the assessment of reliability of practical designs and machine elements.

Skills

- Be able to assess the stability of cracks using Griffith's and Irwin's fracture criteria, energy release rate, and toughness concepts
- Be able to apply linear elastic solutions for sharp cracks and obtain the stress intensity factor.
- Be able to assess mixed mode loading and apply crack growth direction hypotheses
- Be able to assess crack growth by fatigue, partial damage and load spectra.
- Be able to assess crack initiation, notches and their effect.
- Be able to determine life time and apply methods for improving the fatigue strength and life time of machine elements and welded details.

Competences

- Be able to understand and apply linear elastic concepts in assessing the stability of cracked structures under static and fatigue loading.
- Be able to distinguish between different fatigue regimes, i.e. elastic or plastic, and un-cracked or pre-cracked, and apply correct methodology to each case in relevant structures.
- Be able to determine the lifetime of welded components, and explain fatigue in welded components on the basis of fracture mechanical concepts.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, oral examination.

Evaluation criteria: As stated in the Joint Programme Regulations

3.3 Materials Technology, 2nd Semester

3.3.1 Polymers and Polymer Composites

Title: **Polymers and Polymer Composites (15 ECTS)**
(Polymerer og polymer kompositter)

Recommended academic prerequisites:
This module is based on knowledge obtained in 1st Semester

Aim: Students who complete the module are expected to:

Knowledge

- Have gained a comprehensive understanding of polymers.

Skills

- Be able to choose a polymer/polymer composite for a given application
- Be able to specify a material system for a composite to a given application
- Be able to demonstrate understanding of microstructure for polymers and polymer based composites.
- Be able to give a critical evaluation of the methods applied for determining microstructure, chemical composition or mechanical and other properties.
- Be able to use correct terminology.
- Be able to compare theoretical and experimental results.

Competences

- Be able to devise experiments for documentation.
- Be able to set up a realistic hypothesis for the outcome of a process, obtaining a property, or the like, within the field of polymers and polymer based composites.
- Be able to devise an experimental method to falsify or validate a given hypothesis.
- Be able to use advanced experimental techniques within the field of polymers and polymer composites.
- Be able to apply the background theory and the insight obtained, for validation of the material choice for a given application.

Form of instruction: The module is carried out as group-based problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organize and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: External, oral examination

Evaluation criteria: As stated in the Joint Programme Regulations

3.3.2 Fundamental Polymer Chemistry

Title: **Fundamental Polymer Chemistry (5 ECTS)**
(Grundlæggende polymerkemi)

Recommended academic prerequisites:
This module is based on knowledge obtained in 1st Semester

Aim: Students who complete the module are expected to:

Knowledge

- Basic Principles: Molecular weight and polymer solutions,
- Chemical Structure and Polymer Properties
- Polymer Morphology
- Various polymerization processes
- Characterization of polymers, Polyethers, sulfides, and related polymers, Polyamides and related polymers, Heterocyclic polymers, Miscellaneous organic polymers, Inorganic and partially inorganic polymers, Natural Polymers

Skills

- Be able to grasp different polymerization principles
- Be able to understand synthetic routes of functional monomers

Competences

- Characterize macromolecules: from chemical structure to molecular weights and distributions
- Use advanced experimental techniques for documenting modifications to polymers

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, written examination based on laboratory reports.

Evaluation criteria: As stated in the Joint Programme Regulations

3.3.3 Simulation and Measuring of Materials Behavior

Title: **Simulation and Measuring of Materials Behavior (5 ECTS)**
(Simulering og måling af materialeopførsel)

Recommended academic prerequisites:
This module is based on knowledge obtained in 1st Semester

Aim: Students who complete the module are expected to:

Knowledge

- Attain knowledge about describing and modelling the microstructure of materials.
- Be able to apply modelling techniques for simulation of material properties.

Skills

- Be able to use different experimental techniques, such as Raman spectroscopy, dynamic mechanical analysis (DMA), thermo-mechanical analysis (TMA), differential scanning calorimetry (DSC) and Fourier transform infrared spectroscopy (FTIR).
- Be able to simulate selected test techniques or processes utilizing multiphysics software packages.

Competences

- Be able to combine measuring techniques for determining material behaviour, such that techniques for determining mechanical properties are used along with methods for describing microstructure and molecular and atomic structure.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, written examination based on laboratory reports.

Evaluation criteria: As stated in the Joint Programme Regulations

3.3.4 Polymers and Composite Materials

Title: **Polymers and Composite Materials (5 ECTS)**
(Polymerer og kompositmaterialer)

Recommended academic prerequisites:
This module is based on knowledge obtained in 1st Semester

Aim: Students who complete the module are expected to:

Knowledge

- Have gained an in-depth understanding of the overall topical area of polymers and composite materials including their properties, manufacturing, analysis and design.
- Be able to document understanding of following concepts and theories:
    - Applications of composites: past, present and future.
    - Fibers and polymer resin materials: Types and properties.
    - Manufacturing methods, their processing characteristics and influence on the mechanical properties of composites.
    - Laminae and laminates: Micro-mechanical models, modeling of the laminae, classical lamination theory (CLT).
    - Thermal effects.
    - Microstructural Fracture and failure.

Skills

- Be able to apply concepts, theories and methods for analysis and design of composite materials.
- Be able to characterize polymers and composite materials in terms of various experimental techniques.
- Be able to understand the relation between processing conditions and subsequent material properties.

Competences

- Be able to undertake development and product design using polymers and composite materials.
- Be able to develop procedures for production and verification of components made from polymer and composite materials.

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, oral examination based on laboratory work and lectures.

Evaluation criteria: As stated in the Joint Programme Regulations

3.3.5 Polymer Chemistry

Title: **Polymer Chemistry (5 ECTS)**
(Polymerkemi)

Recommended academic prerequisites:
This module is based on knowledge obtained in 1st Semester

Aim: Students who complete the module are expected to:

Knowledge

- Basic Principles: Molecular weight and polymer solutions,
- Chemical Structure and Polymer Properties
- Polymer Morphology
- Step-reaction and ring opening polymerization
- Free radical polymerization
- Ionic Polymerization and
- 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

Skills

- Be able to grasp different polymerization principles
- Be able to understand synthetic routes of functional monomers
- Be able to Perform polymerization under various conditions
- Be able to modify polymer surfaces

Competences

- Characterize macromolecules: from chemical structure to molecular weights and distributions
- Use advanced experimental techniques for documenting modifications to polymers

Form of instruction: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Internal, written examination based on laboratory reports.

Evaluation criteria: As stated in the Joint Programme Regulations

3.4 Materials Technology, 3rd Semester

3.4.1 Industrial Development

Title: **Industrial Development (30 ECTS)**
(Industrielt udviklingsarbejde)

Recommended academic prerequisites:
This module is based on knowledge obtained in 2nd Semester

Aim: Students who complete the module are expected to:

Knowledge

- Have gained knowledge and understanding of advanced materials.
- Be able to apply analytical, numerical and experimental methods in relation to verification of material performance.

Skills

- Be able to describe the problem solved and the criteria applied for its solution.
- Be able to evaluate the concepts, theories, and methodologies applied in the solution of the problem.
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level.
- Be able to assess the limitations of the concepts, theories, and methodologies applied in the solution of the problem.

Competences

- Be able to 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.

Organization: The project may be finalized with a project report or in the form of a scientific paper with supporting appendices.

Form of examination: Oral examination, Internal

Evaluation criteria: As stated in the Joint Programme Regulations

3.4.2 Academic Internship

Title: **Academic Internship (30 ECTS)**
(Projektorienteret forløb i en virksomhed)

Recommended academic prerequisites:
This module is based on knowledge obtained in 2nd Semester

Aim: Students who complete the module are expected to:

Knowledge

- Have gained knowledge and understanding of advanced materials.
- Be able to apply analytical, numerical and experimental methods in relation to verification of material performance.

Skills

- Be able to describe the problem solved and the criteria applied for its solution.
- Be able to evaluate the concepts, theories, and methodologies applied in the solution of the problem.
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level.
- Be able to assess the limitations of the concepts, theories, and methodologies applied in the solution of the problem.

Competences

- Be able to 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.

Form 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..

Form of examination: Oral examination, Internal

Evaluation criteria: As stated in the Joint Programme Regulations

3.5 Materials Technology, 4th Semester

3.5.1 Master's Thesis

Title: **Master's Thesis (30 or 60 ECTS)**
(Kandidatspeciale)
The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.

Aim: Students who complete the module are expected to:

Knowledge

- Have attained thorough understanding of a broad range of theoretical, numerical and experimental techniques within the area of Materials Engineering.

Skills

- Be able to apply scientific methodology to solve a wide variety of problems within the field of specialization.
- Be able to perform scientific work in relevant topics in the field of specialization.
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialization.
- Be able to participate in or lead projects in materials technology, product development, modeling and analysis of material systems and production technology.
- The graduates are expected to have gained a broad knowledge within the areas of Materials Technology. The graduates have knowledge about qualified materials selection, materials behavior to external stimuli, influence of processing on material properties and material microstructure, metallurgy, issues related to polymer chemistry, various material testing methods and simulation of material behavior.

Competences

- 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
- Be able to direct the technical management of development projects within industry.
- Be competent to solve new and complicated technical problems by the use of advanced analytical and experimental techniques.

Form of instruction: In this module, the Master's project is carried out. The module constitutes independent project work and concludes the programme. Within the approved topic, the Master's project must document that the level for the programme has been attained.

Form of examination: Individual oral examination with participation of an external examiner.

Evaluation criteria: As stated in the Joint Programme Regulations

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of September 2017.

Students who wish to complete their studies under the previous curriculum from 2016 must conclude their education by the summer examination period 2018 at the latest, since examinations under the previous curriculum are not offered after this time.

Chapter 5: Other Provisions

5.1 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 spelling and formulation 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 language performance alone; similarly, an examination normally cannot be assessed as 'Fail' on the basis of poor language performance alone. The Board of Studies 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.[5] If the project is written in English, the summary must be in Danish.[6] The summary must be at least 1 page and not more than 2 pages. The summary is included in the evaluation of the project as a whole.

5.2 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 Board of Studies can approve successfully completed (passed) programme elements from other Master's programmes in lieu of programme elements in this programme (credit transfer). The Board of Studies can also approve successfully completed (passed) programme elements from another Danish programme or a programme outside of Denmark at the same level in lieu of programme elements within this curriculum. Decisions on credit transfer are made by the Board of Studies based on an academic assessment. See the Joint programme regulations for the rules on credit transfer.

5.3 Rules for examinations

The rules for examinations are stated in the Examination Policies and Procedures published by the Faculties of Engineering and Science on their website.

5.4 Exemption

In exceptional circumstances, the Board of Studies study can grant exemption from those parts of the curriculum that are not stipulated by law or ministerial order. Exemption regarding an examination applies to the immediate examination.

5.5 Rules and requirements concerning the reading of texts in foreign languages and a statement of the foreign language knowledge this assumes

It is assumed that the student can read academic texts in modern Danish, Norwegian, Swedish and English and use reference works, etc., in other European languages.

[5] Or another foreign language (upon approval from the Board of Studies)
[6] The Board of Studies can grant exemption from this.

5.6 Additional information

The current version of the curriculum is published on the Board of Studies' website, including more detailed information about the programme, including exams.