The Faculty of Engineering and Science
Board of Studies for Civil Engineering

AALBORG UNIVERSITET

Curriculum for
The Master's Programme in Mechanical Design

Aalborg University
September 2017
Version 2

Godkendt d. 20/12 17

Mogens Rysholt Poulsen
dekan

Campus: Esbjerg

The Faculty of Engineering and Science
Board of Studies for Civil Engineering

AALBORG UNIVERSITET

Curriculum for
The Master's Programme in Mechanical Design

Aalborg University
September 2017
Version 2

Campus: Esbjerg

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 Mechanical Design is stipulated. The programme also follows the Joint Programme Regulations and the Examination Policies and Procedures for The Faculty of Engineering and Science.

Table of Contents

Chapter 1: Legal Basis of the Curriculum, etc. 3

1.1 Basis in ministerial orders 3
1.2 Faculty affiliation 3
1.3 Board of Studies affiliation 3
1.4. External Evaluation Corps 3

Chapter 2: Admission, Degree Designation, Program Duration and Competence Profile 3

2.1 Admission 3
2.2 Degree designation in Danish and English 3
2.3 The program's specification in ECTS credits 3
2.4 Competence profile on the diploma 4
2.5 Competence profile of the program 4

Chapter 3: Content and Organization of the Program 5

3.1 Overview of the program 6

3.2 1st semester 8

3.2.1 Introduction to Problembased Learning within Structural and Mechanical Engineering 8
3.2.3 Stiffness Analysis of Load-Bearing Structures (10 ECTS) 9
3.2.4 Structural Mechanics and Dynamics (5 ECTS) 11
3.2.5 Material Modelling in Mechanical Design (5 ECTS) 12
3.2.5 Fluid and Wave Dynamics (5 ECTS) 13

3.3 2nd semester 14

3.3.1 Offshore Structures (15 ECTS) 14
3.3.2 Coastal, Offshore and Port Engineering (5 ECTS) 15
3.3.3 Advanced Structural Engineering (5 ECTS) 16
3.3.4 Risk and Reliability in Engineering (5 ECTS) 17

3.4 3rd semester 18

3.4.1 Analysis and Solution of Advanced Mechanical and/or Offshore Engineering Problems 18
3.4.2 Renewable Energy Structures: Wind Turbines and Wave Energy Devices (5 ECTS) 19
3.4.3 Wind Loads on Structures (5 ECTS) 20
3.4.4 Fracture Mechanics and Fatigue (5 ECTS) 21
3.4.5 Academic Internship (30 ECTS) 22

3.4 4th semester 23

3.4.1 Master's Thesis (30, 45, 60 ECTS) 23

Chapter 4: Entry into Force, Interim Provisions and Revision 24

Chapter 5: Other Provisions 24

5.1 Rules concerning written work, including the Master's thesis 24
5.2 Rules concerning credit transfer (*merit*), including the possibility for choice of modules that are part of another program at a university in Denmark or abroad 24
5.3 Rules for examinations 24
5.4 Exemption 25
5.5 Rules and requirements for the reading of texts 25
5.6 Additional information 25

Chapter 1: Legal Basis of the Curriculum, etc.

1.1 Basis in ministerial orders
The Master's programme in Mechanical Design is organised in accordance with the Ministry of Higher Education and Science's Order no. 1061 of June 30, 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. 258 of March 18, 2015 (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 Civil Engineering

1.4. External Evaluation Corps
The programme falls under the external evaluator corps: ingeniøruddannelsernes censorkorps - bygning.

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

2.1 Admission
Applicants with a legal claim to admission (retskrav):
Applicants with the following degree are entitled to admission:

- Bachelor of Science (BSc) in Engineering (Mechanical Design), Aalborg University

Applicants without legal claim to admission:
Bachelor's programmes qualifying students for admission:

- Bachelor of Science (BSc) in Engineering (Mechanical Engineering and Manufacturing). Aalborg University
- Bachelor of Science in Mechanical Engineering, DTU
- Bachelor of Engineering in Mechanical Engineering. Aalborg University, Aalborg
- Bachelor of Engineering in Mechanical Engineering. Aalborg University, Esbjerg
- Bachelor of Engineering in Mechanical Engineering, SDU
- Bachelor of Engineering in Mechanical Engineering, Aarhus University
- Bachelor of Engineering in Mechanical Engineering, DTU
- Bachelor of Engineering in Mechanical Engineering, VIA University College

2.2 Degree designation in Danish and English
The Master's program entitles the graduate to the designation civilingeniør, cand.polyt. i maskinkonstruktion. The English designation is: Master of Science (MSc) in Engineering (Mechanical Design).

2.3 The program's specification in ECTS credits
The Master's program is a 2-year, research-based, full-time study program. The program 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 program

The graduate of the Master's program:

Knowledge
Has knowledge in one or more subject areas that is based on the highest international research within the fields of mechanical and offshore engineering, such as:

- structural behaviour of mechanical and/or offshore structures regarding the static as well as the dynamic response
- structure-fluid interaction,
- construction materials regarding their mechanical behaviour and modelling
- loads, especially environmental loads like wind and wave loads, and methods for their evaluation
- risk and reliability in engineering including uncertainties of loads, geometry, material properties, structural response and computational models

Can select and explain appropriate analytical, numerical and experimental methods for analysis and design of mechanical and/or offshore structures

Skills
Excels in the scientific methods and tools as well as general skills related to employment within mechanical and offshore engineering, such as

- applying appropriate methods of analysis for investigating mechanical structures and construction materials
- assessing loads on mechanical structures, including environmental loading from wind and waves
- assessing the uncertainty connected with structural analysis, and judge the quality of the results
- applying experimental tests for obtaining material properties, calibrating computational models and assess uncertainties within the fields of mechanical and offshore engineering.
- can identify scientific problems within mechanical and offshore engineering and select and apply proper scientific theories, methods and tools for their solution
- can select and apply appropriate methods for solving a

given problem within mechanical and offshore engineering and judge the results regarding their accuracy and validity
- can select and apply appropriate computational and experimental methods to investigate the static and dynamic response of mechanical structures
- can communicate research-based knowledge and discuss professional and scientific problems with peers as well as non-specialists, using the correct terminology in mechanical and offshore engineering

Competences

- Can manage work-related situations that are complex and unpredictable, and which require new solutions
- Can develop and advance new analyses and solutions within mechanical and offshore engineering
- Can initiate and implement discipline-specific as well as interdisciplinary cooperation and assume professional responsibility
- Can take responsibility for own professional development and specialisation

Chapter 3: Content and Organization of the Program

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

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

- project work
- lectures
- classroom instructions
- study groups
- workshop
- exercises
- laboratory tests
- measurements and testing in the field
- portfolio work
- independent study

If the number of students following a module is small and/or if the number of students having to attend a re-exam is small the study board can decide that an exam is conducted either as an oral or written individual exam. In the first case decision must be notified before the start of the teaching activity in the latter case the students must be notified when the examination date is decided.

3.1 Overview of the program

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).

Of a total of 120 ECTS, 120 ECTS are assessed by the 7-point scale and 45-75 ECTS are assessed by external examination.

Semester		Module	ECTS	Assessment	Exam
1st		Introduction to Problem Based Learning within Structural and Mechanical Engineering (P) [3)]	5	7-point scale	Internal
		Stiffness analysis of Load-Bearing Structures (P)	10	7-point scale	Internal
		Structural Mechanics and Dynamics	5	7-point scale	Internal
		Material Modelling in Mechanical Design	5	7-point scale	Internal
		Fluid and Wave Dynamics	5	7-point scale	Internal
2nd		Offshore Structures (P)	15	7-point scale	External
		Coastal, Offshore and Port Engineering	5	7-point scale	Internal
		Advanced Structural Engineering	5	7-point scale	Internal
		Risk and Reliability in Engineering	5	7-point scale	Internal
3rd	A	Analysis and Solution of Advanced Mechanical and/or Offshore Engineering Problems (P)	15	7-point scale	Internal
		Renewable Energy Structures: Wind Turbines and Wave Energy Devices	5	7-point scale	Internal
		Wind Loads on Structures	5	7-point scale	Internal
		Fracture Mechanics and Fatigue	5	7-point scale	Internal
	B	Academic Intership[1]	30	7-point scale	Internal
	C	Study at other university[2]	15-30	See below -[2)]	See below -[2)]
3rd- 4th		Master's Thesis after 3 of the 3rd semester courses	45	7-point scale	External
3rd- 4th		Master's Thesis	60	7-point scale	External
4th		Master's Thesis	30	7-point scale	External
Total			120		

1) The study board must approve on the content of the Internship, before it is commenced.
2) Assessment and exam according to the curriculum at the other university. The study board must approve on the contents before the study is commenced.
3) Students not familiar with Problem-based Learning at Aalborg University must attend the course "Problem-based Learning (PBL) and Project Management" as an integrated part of the project module on 1st, 2nd or 3rd semester, at the first semester studying at Aalborg University.

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 Mechanical and Offshore Engineering and the students have the choice of making a long master's thesis comprising both semesters.

If option C is chosen on the 3rd semester - the study board must approve on the contents before the study is commenced. The amount of ECTS followed at the other university must be 15 or 30 ECTS such that the size of the master's thesis is the remainder of the ECTS up to 60 ECTS for both the 3rd and the 4th semester.

The students are given options in the project modules as they can select among different projects within the same general theme. Moreover, the Master's Thesis can be selected freely within the field of Mechanical and Offshore Engineering.

The study board of civil engineering can decide, that the contents of a course module on a semester is taught in the project module in the same semester, by increasing the ECTS extend of the project module by the same number of ECTS. The decision is taken regarding to capacity and/or economy.

3.2 1st semester

3.2.1 Introduction to Problembased Learning within Structural and Mechanical Engineering (5 ECTS)

Introduktion til problembaseret læring inden for bygge- og anlægskonstruktion

Objective

Students who complete the module:

Knowledge

- Must have knowledge about Problem Based Learning (PBL).
- Must have knowledge about the Aalborg model approach to PBL.
- Must have knowledge about various techniques for planning and management of the group-based project work.
- Must have a basic fundamental knowledge about analytical, numerical and experimental work for estimating the response of a simple structural part (deformations and/or stresses and strains).
- Have a basic knowledge about uncertainties and limitations of different types of modelling and testing when analyzing a simple structural part.

Skills

- Must be able to plan and manage a problem-based and project-organized study project carried out by a project group.
- Must be able to communicate project results and processes in a coherent, structured and understandable manner, both in writing, verbally and graphically.
- Must be able to analyze and evaluate own study efforts and learning in relation to a problem-based group work with a view to continued professional development.
- Must be able to analyze and evaluate collective learning processes for joint knowledge development and exchange of experience.
- Be able to perform analytical, numerical and experimental analysis in order to obtain the response of a simple structural part.
- Be able to compare results and reflect upon assumptions and uncertainties.

Competencies

- Must be able to engage in, reflect on and optimize own participation in a group-based project.
- Must be able to consciously reflect on and develop own learning.
- Must be able to engage in, reflect on and optimize collective learning processes in relation to analyzing a simple structural part.

Type of instruction

Project work with supervision supplemented with instructions lab tests, etc.

Exam format

Individual oral exam based on presentation seminar and project rapport.

Evaluation criteria

As stated in the Joint Programme Regulations

3.2.3 Stiffness Analysis of Load-Bearing Structures (10 ECTS)
Stivhedsanalyse af bærende konstruktioner

Prerequisite
Students holding a bachelor degree from another university than Aalborg University must pass the module Problem Based Learning and Project Management at Aalborg University, prior to sitting the exam.

The module builds on knowledge gained in the courses Structural Mechanics and Dynamics, Material Modelling in Civil Engineering, Fluid and Water Wave Dynamics

Objective
Students who complete the module:

Knowledge
- Know fundamental theories and methods for analysis of structures subject to static loads.
- Understand the behaviour of structures subject to static loading regarding their deformation.
- Understand the solution procedure in Finite Element Analysis of linear elastic static problems.
- Understand methodology for design of experiments and test series and for reduction of ambiguity of experimental results, and for comparability with model predictions.
- Understand elementary and advanced quantification tools, and their application to validation between model and experiment data.
- Have a basic knowledge and understanding of experimental work, including test planning, test conduction, different types of test equipment, modelling of uncertainties and comparison of model and test results using statistical methods.

Skills
- Use the correct terminology for structural analysis and design.
- Be able to apply analytical solution methods based on continuum mechanics for selected static problems.
- Be able to develop and implement a Finite Element software code for analysis of a selected simple structure subject to static loading.
- Be able to use a commercial Finite Element code for analysing a given static structural problem.
- Be able to plan and set up a test for determining basic material properties.
- Be able to plan and set up a test for finding the strength and stiffness of a given structure.
- Be able to perform a probabilistic study of the experimental data in order to quantify the influence of individual parameters.
- Be able to scrutinize a model (analytical or numerical) for comparison with an appropriate experimental study.
- Be able to perform a probabilistic study of the model in order to quantify the level of confidence.
- Be able to count for the level of coherence between test results and model predictions.
- Be able to identify invalid data (outliers).
- Be able to account for common errors and limitations in the processing of model data of experimentally obtained data.

Competencies
- Be able to select appropriate analysis methods for a given structural problem, including analytical, numerical and experimental analysis methods.
- Be able to compare results obtained from different analysis methods and be able to judge the quality of the results.

- Be able to undertake experiment planning and execution for refinement and validation (or rejection) of model-based predictions of phenomena within structural and civil Engineering.
- Be able to quantify errors associated with different types of analysis and evaluate the methods regarding assumptions and simplifications.
- Must be able to communicate the results of the project work in a project report.
- Must be able to contribute successfully to teamwork within the problem area and make a common presentation of the result of the project work.

Type of instruction
Project work with supervision supplemented with instructions, workshops, presentation seminars, lab tests, etc.

Exam format
Individual oral exam based on presentation seminar and project rapport.

Evaluation criteria
As stated in the Joint Programme Regulations
.

3.2.4 Structural Mechanics and Dynamics (5 ECTS)
Strukturel mekanik og dynamik

Objective
Students who complete the module:

Knowledge
- Understand how kinematics of different structural elements are related to general continuum mechanics
- Understand fundamental properties of structural systems with emphasis on their impact on the dynamic response
- Know fundamental theories and methods for analysis of dynamic structural response
- Have an understanding of the solution procedure in Finite Element Analysis of linear elastic dynamic problems
- Have a basic knowledge and understanding of experimental work related to dynamic testing of structures

Skills
- Use correct terminology for structural dynamic analysis
- Based on general continuum mechanics, be able to formulate a model for a given structural problem, and based on the assumed kinematics, to establish a finite element formulation with the aid of the principle of virtual work.
- Be able to analyse the dynamic response of single-degree-of-freedom systems
- Be able to analyse the dynamic response of multi-degree-of-freedom systems
- Be able to analyse the dynamic response of structures in time domain and frequency domain
- Be able to conduct modal analysis of structures
- Develop and implement a Finite Element software code for dynamic analysis of a multi-degree-of-freedom system
- Be able to use a commercial Finite Element code for analysing the dynamic response of a given structure
- Be able to plan and set up a test for determining dynamic structural response

Competencies
- Be able to analyse the dynamic response of a civil engineering structure
- Be able to select appropriate analysis methods for the analysis of dynamic structural response
- Be able to compare results obtained from different analysis methods and be able to judge the quality of the results
- Be able to quantify errors associated with different types of analysis and evaluate the methods regarding assumptions and simplifications

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.2.5 Material Modelling in Mechanical Design (5 ECTS)
Materialemodellering i maskinteknik

Objective
Students who complete the module:

Knowledge
- Understand fundamental properties of construction materials in civil engineering with emphasis on their mechanical response
- Understand fundamental theories and methods for analysis of structural material behaviour, including elasticity and plasticity
- Have an understanding of the implementation of material models into computational codes including the Finite Element Method
- Have a basic knowledge and understanding of experimental work related to calibration of material models

Skills
- Use correct terminology regarding the behaviour and modelling of construction materials
- Be able to formulate a constitutive model for the behaviour of a construction material
- Be able to implement a constitutive model for a construction material into a computer code
- Be able to calibrate a constitutive material model based on laboratory tests
- Be able to conduct numerical analysis of civil engineering problems involving nonlinear material behaviour
- Be able to plan and set up tests for determining material properties and calibrating constitutive models

Competencies
- Be able to analyse the behaviour of construction materials
- Be able to select and apply appropriate material models for the analysis of structural behaviour under different load conditions
- Be able to compare results obtained by different constitutive models and be able to judge the quality of the results

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.2.5 Fluid and Wave Dynamics (5 ECTS)
Strømningslære og bølgehydraulik

Objective
Students who complete the module:

Knowledge
- Must have knowledge about fluid kinematics
- Must have knowledge about stresses in fluids, equation of motion, constitutive models and Navier-Stokes equations
- Must have knowledge about ideal fluids and potential flows, including application of potential theory to simple problems for example circular cylinder and calculation of hydrodynamic mass.
- Must have knowledge and understanding of Reynolds averaging and turbulence models
- Must be able to describe turbulent and laminar boundary layers including understanding of momentum equation for boundary layers
- Must be able to describe wind generated waves
- Must understand the application of potential theory to linear surface waves on a horizontal bed, including description and linearisation of boundary conditions, solving Laplace equation and the dispersion equation.
- Kinematic and dynamic description of linear surface waves, including particle velocities and accelerations, pressure field, particle paths, wave energy, energy flux and group velocity.
- Description of waves in shallow water, i.e. shoaling, refraction, diffraction and wave breaking
- Statistical description of waves in time and frequency domain

Skills
- Must be able to describe assumptions and limitations of mathematical models for different types of flows
- Must be able to apply analytical and semi-empirical methods for mathematical description of fluid dynamic problems.
- Must be able to calculate of kinematics and dynamics of regular linear waves on deep and shallow water
- Must be able to analyse irregular waves in time and frequency domain

Competencies
- Must be able to apply proper terminology in oral, written and graphical communication and documentation within fluid and water wave dynamics.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.3 2nd semester

3.3.1 Offshore Structures (15 ECTS)
Offshore strukturer

Prerequisites
The module builds on knowledge gained on 1st semester.

Objective
Students who complete the module:

Knowledge
- Must have knowledge about design rules for marine structures including methods for deterministic and statistical design of marine structures.
- Must have knowledge about analytical, numerical and experimental methods for investigation of marine and geotechnical problems.

Skills
- Must be able to perform a marine and geotechnical site assessment and a design basis
- Must be able to apply advanced numerical and experimental methods for analysis and assessment of loads
- Must be able to apply advanced numerical and experimental methods for analysis and assessment of fatigue
- Must be able to compare and evaluate limitations and uncertainties related to simple and advanced methods for estimation of environmental load as well as synergistic effects and deformations.
- Must be able to evaluate safety by application of statistical methods for assessment of loads and bearing capacity of marine structures.

Competencies
- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within marine structures.
- Must have an overview of design aspects related to marine structures.
- Must be able to communicate the results of the project work in a project report
- Must be able to teamwork within the problem area and make a common presentation of the result of the project work

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Oral exam based on project rapport.

Evaluation criteria
As stated in the Joint Programme Regulations

3.3.2 Coastal, Offshore and Port Engineering (5 ECTS)
Vandbygning

Prerequisites
The module builds on knowledge gained in Fluid and Water Wave Dynamics

Objective
Students who complete the module:

Knowledge
- Must have knowledge about non-linear waves, including 2^{nd} and 5^{th} order and stream function theory
- Must have knowledge about methods for extreme climate analysis
- Must have knowledge about currents and water level variations in the coastal zone
- Must have knowledge about environmental loads on coastal, offshore and port structures including ice, wave, current and wind loads.
- Must have knowledge about sediment transport, scour and scour protection
- Must have knowledge about port layout and design of breakwaters

Skills
- Must be able to calculate design wave height from wave observations
- Must be able to make a conceptual calculation of characteristic wave loads for coastal, offshore and port structures

Competencies
- Must be able to apply proper terminology in oral, written and graphical communication and documentation within coastal, offshore and port engineering.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.3.3 Advanced Structural Engineering (5 ECTS)
Avancerede konstruktionsanalyser

Prerequisites
The module builds on knowledge gained on 1st semester.

Objective
Students who complete the module:

Knowledge
- Should have basic knowledge about non-linear effects in structural response, i.e. influence of large displacements, plasticity or other non-linear material behavior and dynamic effects.
- Should have knowledge about advanced structural analysis and its applications in engineering.
- Should have knowledge about non-linear behavior of thin-walled structures i.e. buckling and postbuckling behavior and influence of geometric imperfections.
- Should have knowledge of modeling joints in structures linear as well as non-linear.
- Should have knowledge about non-linear Finite Element analysis of thin-walled structures.

Skills
- Should be able to formulate a mechanical/matematical model for structures behaving non-linearly.
- Should be able to formulate geometrically non-linear models for thin-walled structures involving buckling, postbuckling and imperfection sensitivity.
- Should be able to estimate the stability load for simplified thin-walled structures based on analytical models.
- Should be able to formulate mechanical/mathematical models for joints in structures e.g. flexible joints in frame structures.
- Should have sufficient background to choose an appropriate numerical model i.e. type of element and type of non-linear solution algorithm.
- Should be able to analyze a structure/structural component by a non-linear Finite Element code
- Should be able to verify the numerical results from Finite Element calculations by analytical models or other simplified models.
- Should be able to interpret the results from a non-linear Finite Element calculation

Competencies
- Should be able to participate in non-linear analysis of engineering structures and participate in a dialog on structural modifications in order to improve the structural response.
- Should be able to model and analyze thin-walled structures with geometric non-linear behavior and participate in a dialog of non-linear analysis of other structures.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.3.4 Risk and Reliability in Engineering (5 ECTS)

Risiko og sikkerhed af konstruktioner

Prerequisites

The module builds on knowledge gained in Probability Theory and Statistics

Objective

Students who complete the module:

Knowledge

- Understand the concepts risk, uncertainty, reliability and safety
- Know statistical methods for modeling physical, model, statistical and measurement uncertainties
- Know methods for assessment of reliability of structural systems using probabilistic methods
- Know methods for systems reliability for non-structural components and its applications in engineering

Skills

- Be able to model physical, statistical, model and measurement uncertainties
- Be able to use failure rates and hazard functions to model failures in systems reliability for non-structural components
- Be able to model uncertainties for loads and strengths
- Be able to estimate the reliability by FORM/SORM methods (reliability index method) and by simulation
- Be able to model system behavior and estimate the reliability of series and parallel systems
- Understand basic concepts of stochastic processes and time-variant reliability methods
- Be able to estimate characteristic and design values for strength parameters and load bearing capacities, and for environmental loads and load effects using test data and measurements
- Be able to calibrate partial safety factors and load combination factors
- Be able to apply Bayesian statistical methods
- Be able to apply of risk & reliability methods for probabilistic design of engineering structures such as buildings, bridges, offshore structures, costal structures, wind turbines etc.
- Use correct professional terminology

Competencies

- Be able to participate in a dialog on modeling of uncertainties, risk analysis and assessment of reliability of structural and non-structural components and systems
- Be able to model, calculate and communicate risk analysis, modeling of uncertainties and assessment of reliabilities for engineering problems.

Type of instruction

Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format

Individual oral or written exam

Evaluation criteria

As stated in the Joint Programme Regulations

3.4 3rd semester

3.4.1 Analysis and Solution of Advanced Mechanical and/or Offshore Engineering Problems (15 ECTS)

Analyse og løsning af avancerede problemer indenfor maskin- eller offshore konstruktioner

Prerequisites

The module builds on knowledge gained the 1st and 2nd semester.

Objective

Students who complete the module:

Knowledge

- Must have knowledge about analytical, numerical and experimental methods for investigation of the chosen problem.

Skills

- Must be able to apply advanced analytical and/or numerical and/or experimental methods for analysis and assessment of the chosen problem.
- Must be able to compare and evaluate limitations and uncertainties related to the methods used for solving the chosen problem.

Competencies

- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within the chosen field.
- Must be able to communicate the results of the project work in a project report
- Must be able to contribute successfully to teamwork within the problem area and make a common presentation of the result of the project work

Type of instruction

Project work with supervision supplemented with instructions, workshops, presentation seminars, lab tests, etc.

Exam format

Oral exam based on project rapport.

Evaluation criteria

As stated in the Joint Programme Regulations

3.4.2 Renewable Energy Structures: Wind Turbines and Wave Energy Devices (5 ECTS)
Konstruktioner til vedvarende energi: vindmøller og bølgeenergianlæg

Prerequisites
The module builds on knowledge gained in the course modules: Structural Mechanics and Dynamics, Risk and Reliability in Engineering, Fluid and Water Wave Dynamics, Coastal, Offshore and Port Engineering

Objective
Students who complete the module:

Knowledge
- Understand basic functioning of wind turbines and wave energy devices
- Know methods for design of main structural components for wind turbines and wave energy devices

Skills
- Be able to assess wave energy resources and wave loads on wave energy devices
- Be able to assess load effects in structural elements in wave energy devices, and verification for ULS and fatigue limit states
- Be able to assess correlation between wind wave and current, incl. weather windows
- Be able to apply methods for verification of sufficient reliability of wind turbines
- Be able to apply basic aerodynamics, aeroelasticity and rotordynamics for wind turbines
- Be able to assess wind energy resources
- Be able to assess load effects in structural elements in wind turbines, and verification for ULS and fatigue during operation and stand-still
- Use correct professional terminology

Competencies
- Be able to understand and communicate basic design problems for wind turbines and wave energy devices.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.4.3 Wind Loads on Structures (5 ECTS)
Vindlast på konstruktioner

Prerequisites
The module builds on knowledge gained in the course modules Structural Mechanics and Dynamics, Risk and Reliability in Engineering

Objective
Students who complete the module:

Knowledge
- Understand the nature of wind: wind profile, mean wind, extreme wind, turbulence, turbulence field – for applications for structures such as buildings, bridges and wind turbines.
- Understand modeling and calculation of wind loads on civil engineering structures
- Understand stochastic processes, stochastic dynamics and wind actions on structures
- Understand basic stochastic dynamics and its applications in engineering, especially for wind actions

Skills
- Be able to calculate static and dynamic wind loads on buildings
- Be able to assess cross-wind load actions such as rhythmic vortex shedding and galloping
- Be able to assess structures exposed to wind load in ULS and SLS (comfort)
- Be able to apply rules for wind actions in design codes
- Be able to assess wind loads on bridges
- Use correct professional terminology

Competencies:
- Be able to model, calculate and communicate wind loads on civil engineering structures.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests.

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.4.4 Fracture Mechanics and Fatigue (5 ECTS)
Brudmekanik og udmattelse

Prerequisites
The module builds on knowledge gained in the course module in Structural Mechanics and Dynamics

Objective
Students who complete the module:

Knowledge
- Should have basic knowledge about fracture mechanics analysis in order to establish criteria for crack initiation and crack growth.
- Should have knowledge about application of fracture mechanics in engineering applications.
- Should have knowledge about models for analysis of fatigue i.e. models for crack growth and influence of loading sequences.
- Should have knowledge about application of fatigue analysis in engineering applications.

Skills
- Should understand the stress and strain variations near a crack tip.
- Should understand and be able to perform quantitative and qualitative analysis of stress intensity factors.
- Should understand the crack driving force based on energy analysis.
- Should understand the influence of plasticity in the fracture process.
- Should understand the basic models for crack growth.
- Should understand different scenarios in fatigue analysis e.g. stress or strain driven, low- or high cycle fatigue.
- Should understand and be able to use methods for analysis of stress variations (e.g. Rain-Flow counting).
- Should understand and be able to use Palmgren-Miners damage model.
- Should be able to calculate the lifetime of welded components.
- Use correct professional terminology

Competencies
- Should be able to participate in analysis of risk of fracture in engineering structures and in a dialog on structural modifications in order to reduce the risk of fracture.
- Should be able to model, calculate and communicate fatigue analysis of welded structures and participate in a dialog of fatigue analysis of other structural components.

Type of instruction
Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests

Exam format
Individual oral or written exam

Evaluation criteria
As stated in the Joint Programme Regulations

3.4.5 Academic Internship (30 ECTS)
Virksomhedsophold

Prerequisites
The module builds on knowledge gained on the 1st and 2nd semester modules

Objective
Students who complete the module:

Knowledge
- Must have knowledge about analytical, numerical and/or experimental methods for investigation of advanced problems within the company's field.

Skills
- Must be able to apply advanced analytical, numerical and/or experimental methods for analysis and assessment of advanced problems within the company's field.
- Must be able to compare and evaluate limitations and uncertainties related to the methods used for solving advanced problems within the company's field.

Competencies
- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within the company's field.
- Must be able to communicate the results of the project work in a project report

Type of instruction
Traineeship in a company and project work. The study board must approve on the content of the project work before the Traineeship is commenced.

Exam format
Individual oral exam based on presentation seminar and project rapport.

Evaluation criteria
As stated in the Joint Programme Regulations

3.4 4th semester

3.4.1 Master's Thesis (30, 45, 60 ECTS)
Kandidatspeciale

The master thesis can be conducted as a long master thesis. 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.

Prerequisites
1st – 3rd Semester

Objective
After completion of the project, the student should within the following topics:

Knowledge
- Have knowledge and comprehension within the field of the specialization at the highest international level
- Be able to critically evaluate knowledge and identify new scientific problems within the field of the specialization
- Have understanding of implications within the related research area including research ethics

Skills
- Independently explain choice of scientific theoretical and/or experimental methods
- During the project and when finalising it make an independent and critical estimation of the chosen theories and methods as well as the analyses, results and conclusions
- Be able to apply a wide range of engineering methods in research and development in the field of specialization
- Be able to communicate relevant scientific and professional aspects of project work in a clear and systematic way both to specialists and the public

Competencies
- Be able to work independently with a project on a specific problem within the field of the specialization at the highest international level
- Independently be able to define and analyse scientific problems and based on that make and state the reasons for the decisions made
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge
- Be able to evaluate the progress of the project independently and select and include additional literature, experiments or data when needed in order to maintain a scientific basis for the project
- Be able to control complex and unexpected working situations and be able to develop new solutions
- Must be able to communicate the results of the project work in a project report

Type of instruction
Project work with supervision supplemented with instructions, workshops, presentation seminars, lab tests, etc.

Exam format
Oral exam based on project rapport.

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 2014 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.

The curriculum must be revised no later than 5 years after its entry into force.

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 good 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.[1] If the project is written in English, the summary must be in Danish.[2] 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 program at a university in Denmark or abroad

In the individual case, 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 Faculty of Engineering and Science on their website.

All students who have not participated in Aalborg University's PBL introductory course during their Bachelor's degree must attend the introductory course "Problem-based Learning and Project Management". The introductory course must be approved before the student can participate in the project exam. For further information, please see the School of Engineering and Science's website.

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

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 for the reading of texts
At programmes that are taught in Danish, 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. At programmes taught in English, it is assumed that the student can read academic text and use reference works, etc., in English.

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