AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN (CAND.POLYT.) I BYGGE- OG ANLÆGSKONSTRUKTION, 2019, AALBORG

CIVILINGENIØR
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

STIFFNESS ANALYSIS OF LOAD-BEARING STRUCTURES

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 10 ECTS project module, the workload is expected to be 300 hours for the student.

EXAM

EXAMS

Name of exam	Stiffness Analysis of Load-Bearing Structures
Type of exam	Oral exam based on a project Oral group exam based on presentation seminar and project report.
ECTS	10
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	Stivhedsanalyse af bærende konstruktioner
Module code	B-BK-K1A-2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	10
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Frier

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

INTRODUCTION TO PROBLEM BASED LEARNING WITHIN STRUCTURAL AND CIVIL ENGINEERING

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Introduction to Problem Based Learning within Structural and Civil Engineering
Type of exam	Oral exam based on a project Individual oral exam based on presentation seminar and project report.

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	Introduktion til problembaseret læring inden for bygge- og anlægskonstruktion
Module code	B-BK-K1A-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Frier

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

STRUCTURAL MECHANICS AND DYNAMICS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Structural Mechanics and Dynamics
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	Strukturel Mekanik og Dynamik
Module code	B-BK-K1A-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Frier

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

MATERIAL MODELLING IN CIVIL ENGINEERING

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Understand fundamental properties of structures and 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.
- Understand fundamental continuum mechanics theories for solids, plates and beams.
- 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 set up the static, kinematic and constitutive relations for solving a mechanical problem.
- Be able to apply the principle of virtual work in solving mechanical problems.
- Be able to apply classical elastic and plastic material models for simulating structural material behaviour.

COMPETENCES

- Be able to analyse the behaviour of structures and 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.
- Be able to compare results obtained by different structural 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Material Modelling in Civil Engineering
Type of exam	Written or oral exam Individual oral or written 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	Materialemodellering i byggeri og anlæg
Module code	B-BK-K1A-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Frier

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

FLUID AND WATER WAVE DYNAMICS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Fluid and Water Wave Dynamics
Type of exam	Written or oral exam Individual oral or written 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	Strømningslære og bølgehydraulik
Module code	B-BK-K1A-5
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Christian Frier

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

THE EXCITATION AND FOUNDATION OF MARINE STRUCTURES

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge gained on 1st semester.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about design rules for marine structures including methods for deterministic and probabilistic assessment of loads on 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 and geotechnical response of marine structures.
- Must be able to compare and evaluate limitations and uncertainties related to simple and advanced methods for estimation of environmental load as well as geotechnical bearing capacity and deformations.
- Must be able to evaluate the safety by application of probabilistic methods for assessment of loads and bearing capacity of marine structures.

COMPETENCES

- 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 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the workload is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	The Excitation and Foundation of Marine Structures
Type of exam	Oral exam based on a project Oral group exam based on presentation seminar and project rapport.

ECTS	15
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	Marine konstruktioners belastning og fundering
Module code	B-BK-K2A-6
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Thomas Lykke Andersen
Time allocation for external examiners	B

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

COASTAL, OFFSHORE AND PORT ENGINEERING

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about non-linear waves, including 2nd and 5th 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.

COMPETENCES

- 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

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Coastal, Offshore and Port Engineering
Type of exam	Written or oral exam Individual oral or written 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	Vandbygning
Module code	B-BK-K2A-7
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Thomas Lykke Andersen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

RISK AND RELIABILITY IN ENGINEERING

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge gained in Probability Theory and Statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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 risk and reliability methods for probabilistic design of engineering structures such as buildings, bridges, offshore structures, costal structures, wind turbines etc.
- Use correct professional terminology.

COMPETENCES

- Be able to participate in a dialog on modelling 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, modelling of uncertainties and assessment of reliabilities for engineering problems.

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Risk and Reliability in Engineering
Type of exam	Written or oral exam Individual oral or written 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	Risiko og sikkerhed af konstruktioner
Module code	B-BK-K2A-9
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Thomas Lykke Andersen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

ANALYSIS AND SOLUTION OF AN ADVANCED CIVIL AND/OR STRUCTURAL ENGINEERING PROBLEM

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the workload is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Analysis and Solution of an Advanced Civil and/or Structural Engineering Problem
Type of exam	Oral exam based on a project Oral group exam based on presentation seminar and project rapport.
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	Analyse og løsning af et avanceret problem indenfor byggeri og/eller anlæg
Module code	B-BK-K3A-11
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained on the 1st to 3rd Semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 45 ECTS project module, the workload is expected to be 1350 hours for the student.

The master thesis is conducted as a long master thesis. A long master thesis has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS

EXAM

EXAMS

Name of exam	Master's Thesis

Type of exam	Master's thesis/final project Individual oral exam based on presentation seminar and project rapport.
ECTS	45
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	B-BK-K3A-18
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	45
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen
Time allocation for external examiners	D

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained on the 1st to 3rd Semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 30 ECTS project module, the workload is expected to be 900 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project Individual oral exam based on presentation seminar and project rapport.

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

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-BK-K4A-19
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen
Time allocation for external examiners	D

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

ADVANCED SOIL MECHANICS AND STRUCTURES

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge gained in Material Modelling in Civil Engineering.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must know how to interpret and determinate geotechnical design parameters based on cone penetration tests, and advanced laboratory tests (oedometer and triaxial tests).
- Must have knowledge about upper and lower bound method.
- Must have knowledge about deformations calculation of geotechnical structures.
- Must have knowledge about design of vertically and horizontally loaded piles and pile groups.
- Must have knowledge about constitutive models for soil and calibration of these models from relevant laboratory tests.
- Must have knowledge about numerical methods (FEM-based).
- Must know how to analyse geotechnical structures using FEM based methods, e.g deep excavations or temporary geotechnical constructions.

SKILLS

- Must be able to design and interpret advanced in-situ and laboratory test programs.
- Must be able to explain and use advanced constitutive models used to model soil response.
- Must be able to design vertical and horizontal loaded piles and pile groups.
- Must be able to analyse geotechnical structures using FEM based methods, e.g. deep excavations or temporary geotechnical structures.

COMPETENCES

- Be able to participate in dialog on modelling of advanced soil mechanics
- Be able to model, calculate, communicate and performe advanced numerical analysis of geotechnical structures.
- Application of proper terminology in oral, written and graphical communication and documentation within Soil Mechanics.

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Soil Mechanics and Structures
Type of exam	Written or oral exam Individual oral or written 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	Videregående geoteknik
Module code	B-BK-K2A-8
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Thomas Lykke Andersen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

ADVANCED STRUCTURAL ENGINEERING

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge gained on 1st semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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 modelling 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/mathematical 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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Structural Engineering
Type of exam	Written or oral exam Individual oral or written 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	Avancerede konstruktionsanalyser
Module code	B-BK-K2A-10
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Thomas Lykke Andersen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

RENEWABLE ENERGY STRUCTURES: WIND TURBINES AND WAVE ENERGY DEVICES

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Renewable Energy Structures: Wind Turbines and Wave Energy Devices
Type of exam	Written or oral exam Individual oral or written 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	Konstruktioner til vedvarende energi: vindmøller og bølgeenergianlæg
Module code	B-BK-K3A-12
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

WIND LOADS ON STRUCTURES

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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 modelling and calculation of wind loads on civil engineering structuresl
- 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 apply methods for stochastic dynamics for application in engineering, especially for wind actions.
- 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.

COMPETENCES

- 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.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Wind Loads on Structures
Type of exam	Written or oral exam Individual oral or written 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	Vindlast på konstruktioner
Module code	B-BK-K3A-13
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

NONLINEAR AND DYNAMIC ANALYSIS OF CIVIL ENGINEERING STRUCTURES

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge gained in the course modules: Structural Mechanics and Dynamics and Material Modelling in Civil Engineering

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have a general overview of nonlinear effects and mechanisms in civil and structural engineering.
- Understand numerical solution schemes for nonlinear analysis.
- Understand nonlinear constitutive behaviour of granular materials, including concrete.
- Understand numerical treatment of elastoplasticity, including hardening, nonassociated plasticity and strain localization.
- Understand wave propagation in solids, structures and fluids and related mechanisms, including dissipation and dispersion.
- Understand numerical solution schemes for wave propagation.

SKILLS

- Be able to apply the finite-element method for analysis of nonlinear problems involving granular materials.
- Be able to apply the finite-element method for analysis of wave propagation in solids, structures and fluids.
- Be able to analyse nonlinear and dynamic response of reinforced concrete structures with the finite-element method.
- Use correct professional terminology.

COMPETENCES

- Be able to choose and develop strategies for numerical analysis of problems involving nonlinear material behaviour and/or wave propagation, including judgement of parameters and shortcomings of the models.
- Be able to identify and apply proper numerical solution techniques and material models for assessment of reinforced concrete structures in the serviceability and ultimate limit states.

TYPE OF INSTRUCTION

Lectures, etc. supplemented with project work, workshops.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS project module, the workload is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Nonlinear and Dynamic Analysis of Civil Engineering Structures
Type of exam	Oral exam

	Individual oral exam based on portfolio work in groups.
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	Ikkelineær og dynamisk analyse af bygge- og anlægskonstruktioner
Module code	B-BK-K3A-14
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Johan Clausen

ORGANISATION

Study Board	Study Board of the Build Environment
Department	Department of the Built Environment
Faculty	Faculty of Engineering and Science

FRACTURE MECHANICS AND FATIGUE

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Fracture Mechanics and Fatigue
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	Brudmekanik og udmattelse
Module code	M-DMS-K1-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Jan Schjødt-Thomsen, Jens Henrik Andreasen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science