AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN (CAND.POLYT.) I VAND OG MILJØ, 2017, VERSION 2

CIVILINGENIØR
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

SOIL AND GROUNDWATER POLLUTION

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in e.g. the courses Experimental Hydrology, Environmental Soil Science and Geostatistics.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Knowledge on technology and applicability of in-situ physical and biological methods for remediation of contaminated soil and groundwater zones at polluted soil sites.

SKILLS

- To analyse, synthesize and evaluate contaminant spill situations in regard to risk for area use and soil and groundwater resources around a polluted soil site.
- To apply selected methods to measure water transport parameters, solute transport parameters, gas transport parameters, and/or biodegradation coefficients in soil and groundwater.
- To model transport of fluids (water and/or air) and transport and degradation of contaminants in soil and groundwater, using own models for one dimensional problems and ready-available software for two or three dimensional problems.

COMPETENCES

- To handle soil and groundwater pollution in relation to the groundwater resource, indoor climate, areal use.
- To structure and produce technical documentation of complex problems, methods and results.
- To communicate problems, findings and solutions graphical as well as oral to the relevant target audience.
- 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	Soil and Groundwater Pollution
Type of exam	Oral exam based on a project Oral 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	Jord og grundvandsforurening
Module code	B-VM-K1-1
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	Per Møldrup

ORGANISATION

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

EXPERIMENTAL HYDROLOGY

2020/2021

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- On the groundwater system and its essential properties and parameters.
- On experimental methods for property and parameter estimation of the ground water zone.
- On uncertainty and limitations of the applied methods.

SKILLS

- To select, design and conduct suitable in-situ test for estimating saturated hydraulic properties.
- To select, design and conduct suitable laboratory test for estimating hydraulic saturated hydraulic properties.
- To analyse and evaluate test results and methods regarding suitability and reliability.
- To organise documentation and presentation of measured data.

COMPETENCES

- To describe, analyse, and evaluate a specific part of the groundwater system, regarding its composition and its properties through a planned investigation of the system.
- To structure and plan the project and the work in a group.
- To produce technical documentation of complex problems, methods and results in group cooperation.
- To communicate findings and solutions graphical as well as oral to the relevant target audience.

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	Experimental Hydrology
Type of exam	Written or oral exam Written or oral exam based on presentation seminar and mini-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	Eksperimentel hydrologi

Module code	B-VM-K1-2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Per Møldrup

ORGANISATION

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

ENVIRONMENTAL SOIL SCIENCE AND GEOSTATISTICS 2020/2021

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- On fundamental soil physics.
- On soil texture and structure, physical and chemical phase distribution (solids, water, air), pore-size distribution, water retention, hydraulic conductivity, soil-water sorptivity, unsaturated zone water transport, gas diffusion and chemical transport, sorption and biodegradation.
- On the basic principle of 1D analytical and numerical water and contaminant transport modelling.
- On evaluating the uncertainty of measured data and model results.

SKILLS

- To measure soil hydraulic properties in the laboratory.
- To apply parameter models for water retention, hydraulic conductivity, gas diffusion, and chemical dispersion to measured data or as predictive tools.
- To program and apply analytical and simple numerical water and solute transport models to measured data or in risk assessment.
- To apply relevant geostatistical methods to measured data in the soil and groundwater zones.

COMPETENCES

- To perform preliminary risk assessment and evaluate the conditions for on-site or in-situ clean-up methods for contaminated soil sites.
- To structure and produce technical documentation of complex problems, methods and results.
- To communicate problems, findings and solutions graphical as well as oral to the relevant target audience.

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	Environmental Soil Science and Geostatistics
Type of exam	Written or oral exam Individual oral or written exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Jordfysik og geostatistik
Module code	B-VM-K1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Per Møldrup

ORGANISATION

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

HYDROGEOLOGY AND GROUNDWATER MODELLING

2020/2021

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- On fundamental hydrogeology.
- On the basic principle of numerical groundwater modelling.
- On chemical transport, dispersion, sorption/retardation and degradation in the groundwater zone.
- On evaluating the uncertainty of the model results.

SKILLS

- To collect, analyse and visualise the various data that forms the basis for the conceptual model.
- To construct, calibrate and validate groundwater models.
- To simulate water and contaminate transport.
- To evaluate and quantify modelling uncertainty.

COMPETENCES

- To evaluate and handling hydrological data that forms the basis for groundwater modelling.
- To structure and produce technical documentation of complex problems, methods and results.
- To communicate problems, findings and solutions graphical as well as oral to the relevant target audience.

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	Hydrogeology and Groundwater Modelling
Type of exam	Written or oral exam Individual oral or written exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Hydrogeologi og grundvandsmodellering

Module code	B-VM-K1-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Per Møldrup

ORGANISATION

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

MARINE AND FRESHWATER POLLUTION

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Limnology, Hydrodynamics, Marine Pollution, Time Series Analysis.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Advanced understanding of the physics of freshwater recipients, the coastal zone and estuaries including currents, waves, sediment transport.
- Basic understanding of the ecological conditions in natural waters, including streams, rivers, lakes, estuaries and coastal waters. Understanding the effect of various types of pollution on flora and fauna in these areas.

SKILLS

- Identify the hydrological, chemical and biological processes that are central for the analysis and evaluation in the aquatic environment.
- Explain the environmental impact of selected compounds on aquatic environments.
- Evaluate toxicological effects on an aquatic ecosystem.
- Use impact assessment methods.
- Build and analyse numerical water quality models.
- Apply advanced hydrodynamic and water quality models.
- Evaluate methods for the analysis of changing impacts on aquatic environments.

COMPETENCES

- To plan and design structures for various types of discharges to freshwater recipients, the coastal zone and estuaries.
- To model numerically the importance of necessary treatment for obtain specified demands on the water quality in the system
- To be able to conduct experimental, empirical and/or theoretical investigations which are necessary for the solution of one or more identified problems.
- To perform water quality assessment studies for different types of impacts on different recipients.
- 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

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	Marine and Freshwater Pollution
Type of exam	Oral exam based on a project Oral 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	Forurening af akvatiske systemer
Module code	B-VM-K2-5
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 Ruby Bentzen
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

HYDRODYNAMICS AND TIME SERIES ANALYSIS OF ENVIRONMENTAL FLOWS

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Fundamental Hydraulics, Fundamental Statistics and Differential Equations.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- On advanced hydrodynamics.
- On numerical modelling of turbulent flows.
- On modelling of transport and mixing.
- On environmental flow in coastal zones and estuaries.
- On basic time series analysis.

SKILLS

- To perform a systematic analysis of the physics in the coastal zone and estuaries.
- To perform non-stationary time simulations with advanced hydrodynamic models.
- To analyse time series for persistence and harmonic elements.
- To analyse geophysical flows in the ocean and coastal zone.

COMPETENCES

- To evaluate and handle data that forms the basis of hydrodynamic and water quality modelling.
- To structure and produce technical documentation of complex problems, methods and results.
- To communicate problems, findings and results graphically as well as oral to the relevant target audience.

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	Hydrodynamics and Time Series Analysis of Environmental Flows
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	Hydrodynamik og tidsserieanalyse for miljøhydrauliske forhold
Module code	B-VM-K2-7
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Asbjørn Haaning Nielsen

ORGANISATION

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

MARINE POLLUTION

2020/2021

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- On marine ecosystems.
- On theory for physical, chemical and microbial processes in marine systems.
- On the most common types of marine pollution.

SKILLS

- To understand the exchange of matter between aquatic and terrestrial environments.
- To describe the marine ecosystem, light, salinity and temperature.
- To understand primary production, respiration and re-oxidation.
- To analyse microbial loops, food webs, turnover of C-N-S in aquatic environments.
- To analyse marine sediments.
- To distinguish pollution impacts on individuals, populations and communities.
- To evaluate man-made pollutants (xenobiotics), disease-causing microorganisms (pathogens) in marine waters.
- To assess recreational and bathing water quality and related fecal pollution source tracking.

COMPETENCES

- Work with and analyze nutrient cycling in coastal marine ecosystem.
- Describe important organic and inorganic pollutants and pollution effects in coastal marine waters.
- Evaluate methods to prevent and alleviate antropogenic pollution in coastal marine waters evaluate meth.

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	Marine Pollution
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	Forurening af marine områder
Module code	B-VM-K2-8
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Asbjørn Haaning Nielsen

ORGANISATION

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

LIMNOLOGY

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Fundamental Hydraulics, Biology, Chemistry and Physics.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Of key components of freshwater ecosystems.
- Of relevant theory for physical, chemical and biological processes in freshwater ecosystems.
- Of dominant anthropogenic types of pollution affecting freshwater ecosystems.

SKILLS

- Shall be able to differentiate between major types of streams, rivers and lakes.
- Shall be able to understand the exchange of matter between aquatic and terrestrial environments.
- Shall be able to explain lake and river ecosystem dependence on light, temperature, nutrients and organic matter.
- Shall be able to understand primary production, respiration and re-oxidation in freshwater ecosystems.
- Shall be able to determine the significance of hydraulic conditions on chemical and biological dynamics in lakes and rivers.
- Shall be able to analyse oxygen dynamics in freshwater environments.
- Shall be able to analyse impacts of pollution on biotic communities.
- Shall be able to use existing pollution indicators for running waters and lakes to assess the pollution of a given location.
- Shall be able to account for current river and lake restoration methods.

COMPETENCES

- Work with and analyze biological communities in relation to nutrient dynamics and organic matter cycling in lake and river ecosystems.
- Describe important organic and inorganic pollutants and pollution effects in freshwater ecosystems.
- Evaluate methods to prevent and alleviate anthropogenic perturbations in freshwater ecosystems using existing technologies.

TYPE OF INSTRUCTION

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

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	Limnology
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	Limnologi
Module code	B-VM-K2-9
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Asbjørn Haaning Nielsen

ORGANISATION

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

WASTEWATER TREATMENT SYSTEMS

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Wastewater Treatment

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Account for physical, microbial and chemical methods for separation and treatment of wastewater by activated sludge processes.
- Describe the different microbiological and chemical processes that participate in wastewater treatment.

SKILLS

- Apply methods for design and analysis of wastewater treatment plants.
- Dimension and run a treatment plant.

COMPETENCES

- Should be able to identify problems with existing systems and be able to solve these problems.
- Should be able to conduct experimental, empirical and/or theoretical investigations which are necessary for the solution of one or more identified problems.
- 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

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	Wastewater Treatment Systems
Type of exam	Oral exam based on a project Oral 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	Spildevandsrensning
Module code	B-VM-K2-6
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 Ruby Bentzen
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

FUNDAMENTAL WASTEWATER TREATMENT

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Fundamental Chemistry, Biology and Hydraulics.

NOTE that this course is conducted together with the 6th semester bachelor in Civil Engineering (with specialisation in Water and Environment) (AAU). The intended learning outcome is increased compared to the bachelor level.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Of advanced wastewater treatment.
- Of theory for physical, chemical and microbial treatment and separation processes.
- Of treatment for nutrients (nitrogen and phosphor).
- Of anaerobic processes in activated sludge.
- Of physical separation processes.

SKILLS

- Shall be able to quantify the important biological, chemical and physical processes which is used for a process based wastewater treatment plant design.
- Shall be able to account for the interaction between the physical, microbial and chemical processes and the loading of the treatment plant.
- Shall be able to characterize wastewater.
- Shall be able to optimize wastewater treatment systems.
- Shall be able to design plants for mechanical and chemical treatment of wastewater.
- Shall be able to understand to design activated sludge and biofilm treatment plant for removal of carbon, nitrogen and phosphor.
- Shall be able to understand biological mineralization processes of carbon, nitrogen and phosphor and model these

COMPETENCES

- To plan and design new treatment plants.
- To analyze the function of existing treatment plants.
- To structure and produce technical documentation of complex problems, methods and results.
- To communicate problems, findings and results graphically as well as oral to the relevant target audience.

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	Fundamental Wastewater Treatment
Type of exam	Written or oral exam Individual oral or written exam. The level of complexity of exercises/demands for the master students attending the course is increased in comparison with the bachelor students attending the course.
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	Grundlæggende spildevandsrensning
Module code	B-VM-K2-10
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 Ruby Bentzen

ORGANISATION

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

ADVANCED HYDRODYNAMIC MODELLING (CFD) AND VISUALISATION

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Hydrodynamics.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have knowledge on how problems concerning complex process and flow structures can be approached numerically.
- Shall have knowledge on numerical errors, stability and accuracy of computational fluid dynamic models.
- Shall have knowledge on how result data can be represented graphically static and dynamically.

SKILLS

- Be able to set up a computational fluid dynamic model for a simple and more complex laminar and turbulent flows.
- Be able to choose appropriate boundary condition for the model.
- Be able to calibrate and validate models and interpret results.
- Be able to represent data in time and space based on data generated by field measurements or numerical models.
- Data animation.

COMPETENCES

- To structure, simulate and interpret numerical fluid models.
- To structure and produce documentation of complex 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	Advanced Hydrodynamic Modelling (CFD) and Visualisation
Type of exam	Written or oral exam Individual oral or written exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination

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

FACTS ABOUT THE MODULE

Danish title	Avanceret hydrodynamisk modellering (CFD) og visualisering
Module code	B-VM-K3-13
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	Søren Liedtke Thorndahl

ORGANISATION

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

MEASUREMENT TECHNOLOGY, DATA ACQUISITION, TEST AND VALIDATION

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Basic Programming, Applied Statistics and Probability Theory.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Knowledge on the different sensors available and the fundamental measuring principles.
- Knowledge on the computer based data acquisition, accuracy and error handling.
- Understand methodology for design of experiments and test series and for reduction of ambiguity of experimental results, and for comparability with model predictions.
- Understand processing methods for analog and digital data (continuous vs. discrete).

SKILLS

- Isolate principal measurable parameters.
- Be able to plan experiments in order to get optimal information compared to the experimental effort.
- Be able to choose the right sensor technology for the problem at hand.
- Setting up the A/D and D/A converters with commercial programs or by own programs.
- Isolate principal measurable parameters.
- Basic knowledge on digital image analysis.

COMPETENCES

- Be able to plan a laboratory or field experiment and setup appropriate data acquisition.
- Be able to discuss validity of results and errors of the data acquired in relation to choice of sensor and analysis method.

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	Measurement Technology, Data Acquisition, Test and Validation
Type of exam	Written or oral exam Individual oral or written exam
ECTS	5

Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Måleteknik og dataopsamling
Module code	B-VM-K3-14
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl

ORGANISATION

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

URBAN HYDROINFORMATICS

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Hydrodynamics and Analysis of Time Series, Ground Water Modelling, Hydraulics and Urban Drainage.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module:

- Must have knowledge on complex hydrological, hydraulic, chemical, and biological processes in urban drainage systems.
- Must have knowledge on different numerical models for simulation of relevant complex processes in drainage systems.

SKILLS

Students who complete the module:

- Must be able to apply commercial models for simulation of relevant processes in drainage systems.
- Must be able to develop and code simple models for simulation of relevant processes in drainage systems.
- Must be able to apply methods for calibration and validation of models.
- Must be able to apply probabilistic methods in order to quantify uncertainties in urban drainage models.

COMPETENCES

Students who complete the module:

- Must be able read and understand scientific papers and apply novel methods within urban drainage modelling.
- Must be able to compare observations and simulation results and discuss validity of the latter.

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	Urban Hydroinformatics
Type of exam	Written or oral exam Individual oral or written exam
ECTS	5

Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Urban hydroinformatik
Module code	B-VM-K3-15
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	Søren Liedtke Thorndahl

ORGANISATION

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

ACADEMIC INTERNSHIP

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in 1st and 2nd Semester.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

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.

COMPETENCES

- 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

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

EXTENT AND EXPECTED WORKLOAD

The Project-oriented study in an external organization must have a scope that correspond the ECTS load. Since it is a 30 ECTS project module, the workload is expected to be 900 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project Oral exam based on presentation seminar and project rapport.
ECTS	30
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	Projektorienteret forløb i en virksomhed
Module code	B-VM-K3-17
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl

ORGANISATION

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

MASTER'S THESIS

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in the first three semesters of the master programme.

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 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-VM-K4-21
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl
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

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in the first three semesters of the master programme.

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

When 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.

Since it is a 60 ECTS project module, the workload is expected to be 1800 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis

Type of exam	Master's thesis/final project Oral exam based on presentation seminar and project rapport.
ECTS	60
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-VM-K3-20
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	60
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl
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

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in the first three semesters of the master programme.

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

When 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.

Since it is a 50 ECTS project module, the workload is expected to be 1500 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis

Type of exam	Master's thesis/final project Oral exam based on presentation seminar and project rapport.
ECTS	50
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-VM-K3-19
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	50
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl
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

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in the first three semesters of the master programme.

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

When 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.

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

EXAM

EXAMS

Name of exam	Master's Thesis

Type of exam	Master's thesis/final project 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-VM-K3-18
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	45
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl
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

NUMERICAL MODELLING AND EXPERIMENTAL METHODS

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Hydrodynamics and Time Series Analysis, Measurement Technology and Data Acquisition, Advanced Hydrodynamic Modelling (CFD) and Visualization.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have knowledge on how numerical methods and experiments methods complement each other and how to use experimental data to improve numerical models.
- Shall have knowledge on how uncertainties are associated to each method and how they can be analyzed.

SKILLS

- Be able to measure, model, analyze and visualize fluid dynamics and transport of substances in soluble or particle form.
- Understand key methods for measuring water and turbulent transport.
- Calculate currents and turbulent transport with commercial available models.
- Develop independent numerical models.
- Plan and carry out the measurement program for field and laboratory measurements.
- Analyze errors and uncertainties in the measurement and modelling in natural or environmental engineering systems.

COMPETENCES

- Be able to combine experimental data and numerical methods to develop better models within the area of water and environment.
- To structure and produce technical documentation of complex problems, methods and results.
- Present and communicate results in a web-based media.
- 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	Numerical Modelling and Experimental Methods
Type of exam	Oral exam based on a project Individual oral 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	Numeriske og eksperimentelle metoder
Module code	B-VM-K3-11
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	Søren Liedtke Thorndahl

ORGANISATION

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

ADVANCED URBAN DRAINAGE

2020/2021

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Urban Drainage and Hydraulics.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have knowledge on how urban wastewater and stormwater runoff interacts with our cities and its surrounding environment.
- Understand how this impact can be controlled by using advanced analysis and numerical modelling.

SKILLS

- Understand rainfall processes and transport of storm water on urban surfaces.
- Be able to evaluate the consequences of climate change for urban drainage systems.
- Combine knowledge on hydrodynamic performance of the storm drainage system with knowledge on the consequences in the receiving waters.
- Design a water management strategy for city areas so they can cope with increased precipitation.

COMPETENCES

- Be able to plan the drainage structure for an entire city with respect to flooding, receiving water quality and climate change.
- To structure and produce technical documentation of complex problems, methods and results.
- Present and communicate results in a web-based media
- 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	Advanced Urban Drainage
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	Videregående afløbsteknik
Module code	B-VM-K3-12
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Søren Liedtke Thorndahl

ORGANISATION

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