AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN (CAND.POLYT.) I INDEKLIMA OG ENERGI, 2016.

CIVILINGENIØR
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

VENTILATION, AIRFLOW AND CONTAMINANT TRANSPORT IN BUILDINGS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

The module builds on knowledge gained in the modules Numerical Methods, Fluid Mechanics and Computational Fluid Dynamics, Building Related Fluid Mechanics or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must understand the theoretical and experimental assessment of heat, mass, and momentum transfer in ventilated enclosures.
- Must understand the relationship between the thermal comfort, indoor air quality and health issues and the heat, mass and momentum transfer in the micro-environment of a human being

SKILLS

- Must be able to develop and perform model and/or full-scale experiments related to fluid flow and contaminant transport in ventilated enclosures
- Must be able to measure, evaluate and further develop various flow elements for typical room air distribution systems.
- Must be able to perform CFD simulations in ventilation settings including the establishment of proper boundary conditions.
- Must have the ability to design and evaluate different types of air distribution systems in a room and in a building.

COMPETENCES

- Must be able to identify and discuss the optimal solution for an air distribution system based on theory and/or experiments
- Must be able to perform and reflect on experiments related to personal exposure assessment and contaminant transport
- 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	Ventilation, Airflow and Contaminant Transport in Buildings
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Ventilation, luftstrømninger og forureningstransport i bygninger
Module code	B-IE-K1G-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	Chen Zhang, Rasmus Lund Jensen
Time allocation for external examiners	B

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

NUMERICAL METHODS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to understand the analytical solution of partial differential equations including
  - Linear equation systems, Gaussian elimination, factorization methods
- Must be able to understand numerical solution methods including
  - Iterative solution of equations e.g. Gauss-Seidel, ill-conditioned systems of linear equations, matrix eigenvalue problems, solution of non-linear equations, interpolation, splines, numerical solution of integrals, numerical solution of first-order and second-order differential equations

SKILLS

- Must be able to apply numerical methods to solve mathematical problems
- Must be able to apply finite difference and finite element methods including
  - The finite difference method
  - The finite volume method
  - Difference approximations, elliptic equations, Dirichlet og Neumann boundary conditions, parabolic equations, explicit and implicit methods, the Theta method, hyperbolic equations
  - The finite element method

COMPETENCES

- Must be able to apply numerical methods in engineering
- Must be able to contribute independently to professional and multidisciplinary work with a professional knowledge on numerical methods
- Must be able to identify personal learning needs and be able to structure the learning within numerical methods

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	Numerical Methods
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Numeriske metoder
Module code	B-IE-K1G-2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Chen Zhang, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

FLUID MECHANICS AND COMPUTATIONAL FLUID DYNAMICS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete 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.
- 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 have knowledge about numerical methods in fluid mechanics.
- Must have knowledge about the finite volume method of computational fluid dynamics.
- Must have knowledge about mesh types and boundary conditions.

SKILLS

- Must be able to describe assumptions and limitations of mathematical models for different types of flows
- Must be able to apply appropriate analytical, semi-empirical and numerical methods for mathematical description of fluid dynamic problems.
- Must be able to evaluate results from such methods

COMPETENCES

- Must be able to apply proper terminology in oral, written and graphical communication and documentation within fluid dynamics.
- Must be able to apply the topic of the module in multi-disciplinary contexts.

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 Mechanics and Computational Fluid 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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Strømningslære og CFD
Module code	B-IE-K1G-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	Chen Zhang, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

BUILDING RELATED FLUID MECHANICS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must obtain a detailed knowledge of building related heat, mass, and momentum transport
- Must obtain knowledge of building related application of similarity principles and turbulence modelling
- Must understand different simplified procedures, as the generation of flow elements
- Must understand the principles of heat and mass transfer in the micro-environment of a human being

SKILLS

- Must be able to develop the basis for model and/or full-scale experiments
- Must be able to develop flow elements for room air distribution
- Must be able to setup and perform advanced CFD simulations of ventilated buildings including occupant modelling
- Must be able to develop proper boundary conditions for CFD in ventilation
- Have the ability to choose, design and evaluate the different types of air distribution in a room and in a building
- Have the ability to apply relevant models in building related fluid mechanics

COMPETENCES

- The student must be able to establish, evaluate and reflect on models on room air distribution and personal exposure assessment in building related fluid mechanics
- The students must be able to combine and reflect on the various methods applied in the area of building related fluid mechanics and establish relevant solutions

TYPE OF INSTRUCTION

Project work with supervision, etc. supplemented with instructions, 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	Building Related Fluid Mechanics
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Bygningsrelateret strømningsmekanik
Module code	B-IE-K1G-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	Chen Zhang, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

INTEGRATED DESIGN OF BUILDINGS AND BUILDING SERVICES

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge corresponding to 1st semester and knowledge gained in the modules Stochastic Modelling and Design Optimisation, Integrated Building Energy Design and Environmental Assessment Methods and Life Cycle Cost Analysis or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about basic architectural design methodology, the integrated design process and integrated building concepts
- Must have knowledge on choice of passive energy technologies in relation to indoor environment and building services
- Must be able to understand the interplay between microclimate, buildings and their services
- Must be able to understand the interplay between sustainable energy system, building energy demand and renewable energy production
- Must have knowledge of stochastic performance modeling of buildings

SKILLS

- Must be able to apply and combine design methods for passive energy technologies
- Must be able to apply and combine design methods for energy efficient building design
- Must be able to apply, combine and evaluate advanced methods for analysis of the interplay between energy systems, architectural concepts, building design, building use, outdoor climate and HVAC systems
- Must be able to evaluate building energy performance and assess their robustness through sensitivity and uncertainty analyses

COMPETENCES

- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within integrated design of buildings and building services.
- Must be able to handle complex and research-oriented cases related to development of low-energy, energy-neutral and energy-producing buildings
- Must be able to take part in a professional and interdisciplinary collaboration on design of integrated building and energy concepts
- 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	Integrated Design of Buildings and Building Services
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Integreret design af bygninger og bygningsinstallationer
Module code	B-IE-K2G-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	Tine Steen Larsen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

STOCHASTIC MODELLING AND DESIGN OPTIMISATION

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to understand the background and theory of sensitivity analysis and uncertainty analysis in indoor environmental and energy engineering
- Must be able to explain selected methods for stochastic modelling of indoor climate and energy consumption
- Must be able to explain how sensitivity analysis and uncertainty analysis are used in design optimization

SKILLS

- Must be able to investigate, explain and develop indoor environmental and energy engineering models using sensitivity analysis and uncertainty analysis
- Must be able to quantify the influence of uncertainty in indoor environmental and energy engineering using stochastig modelling
- Must be able to apply sensitivity analysis and uncertainty analysis in design optimization

COMPETENCES

- Must be able to choose proper modelling of single zone and multizone buildings and discuss inherent model limitations
- Must be able to discuss and reflect on the accuracy of indoor environmental and energy engineering models subject to uncertainty

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	Stochastic Modelling and Design Optimisation
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	As stated in the Joint Programme Regulations.

	http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Stokastisk modellering og design optimering
Module code	B-IE-K2G-6
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Tine Steen Larsen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

INTEGRATED BUILDING ENERGY DESIGN

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the integrated design process
- Must have knowledge about integrated building concepts
- Must have knowledge of basic architectural design methodology
- Must have knowledge of methods for energy efficient building design
- Must have knowledge of passive energy technologies
- Must be able to understand the microclimate around buildings
- Must be able to understand the interplay between microclimate and buildings
- Must be able to describe the calculation methods related to airflow and pressure distribution around buildings
- Must be able to explain the wind and bouyancy driven flows in single zone modelling
- Describe the mathematical models for multizone modelling

SKILLS

- Must be able to apply basic design methods for passive energy technologies
- Must be able to apply advanced methods for analysis of the interplay between building design, building use and outdoor climate
- Must be able to simulate and analyze the natural airflow of a single zone and a multizone building

COMPETENCES

- Must be able to choose proper modelling of natural and hybrid ventilation in single zone and multizone buildings and discuss inherent model limitations
- Must be able to discuss and reflect on the prospects and limitations of integrated building energy design

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	Integrated Building Energy Design
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Integreret energidesign af bygninger
Module code	B-IE-K2G-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	Tine Steen Larsen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

ENVIRONMENTAL ASSESSMENT METHODS AND LIFE CYCLE COST ANALYSIS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the design philosophy and calculation methods for minimizing the environmental impact of a building throughout its life cycle
- Must have knowledge about the energy and environmental assessment of buildings including material production and transportation, building construction, operation, refurbishment, recycling, demolition and removal
- Must have knowledge about sustainable technologies and environmental design concepts
- Must have knowledge about assessment and certification methods for high performance buildings
- Must have knowledge about LCC analysis
- Must have knowledge about Cost Optimization

SKILLS

- Must be able to perform a Life Cycle Assessment a building
- Must be able to evaluate buildings by using assessment and certification methods for high performance buildings
- Must be able to perform a LCC analysis
- Must be able to automate basic cost optimization

COMPETENCES

- Must be able to discuss and reflect on the prospects and limitations of Environmental Assessment Methods and Tools
- Can evaluate methodologies of building certification methods
- Must be able to evaluate and choose between different building designs based on LCC Analysis and Cost Optimization
- Must be able to discuss and reflect on the prospects and limitations of LCC Analysis and Cost Optimization

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 Assessment Methods and Life Cycle Cost Analysis
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Bæredygtige vurderingsmetoder og LCC analyse
Module code	B-IE-K2G-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	Tine Steen Larsen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

CONTROL AND ANALYSIS OF BUILDING ENERGY SYSTEMS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge on basic control theory, transfer functions, essential strengthening and accuracy of control
- Must have knowledge on feedback control and classical control (P, PI, PID)
- Must have knowledge on models for thermal systems and facilities
- Must have knowledge on state space modelling and control
- Must have knowledge on dynamical modelling and control of HVAC systems

SKILLS

- Must be able to perform analysis and simulation of operational conditions of thermal systems and facility functions
- Must be able to setup a numerical model of the control system/design
- Must be able to device and perform control of a building HVAC system
- Must be able to prescribe functional requirements for building systems control

COMPETENCES

- Must be able to choose and compare different control designs and regulator types
- Must be able to establish evaluate and reflect on control of building energy systems

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	Control and Analysis of Building Energy Systems
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	As stated in the Joint Programme Regulations.

	http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Styring og analyse af bygningers energisystemer
Module code	B-IE-K3G-11
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Mingzhe Liu, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

FAULT DETECTION AND DIAGNOSIS IN BUILDINGS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

A BSc degree in Civil Engineering, Indoor Environmental and Energy Engineering or similar and knowledge gained in the course Control and Analysis of Building Energy Systems or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to describe the energy system of a building and its interaction with the Building Energy Management Systems (BEMS)
- Must be able to understand the different communication protocols
- Must be able to explain commissioning processes
- Must have knowledge on the different sources of faults in buildings
- Must be able to describe methods and tools for fault detection at the component, subsystem or whole building level (model- and monitoring-based techniques)
- Must be able to perform time series analysis

SKILLS

- Must be able to use a Building Energy Management System (BEMS)
- Must be able to select a commissioning plan based on risk and cost analysis
- Must be able to detect the sources of faults in buildings
- Must be able to apply fault detection methods and tools based on short-term tests, including Functional Performance Testing (FPT)
- Must be able to apply fault detection methods and tools based on passive monitoring of buildings

COMPETENCES

- Must be able to combine advanced modelling and measurement techniques to test the performance of components, sub-systems or whole buildings
- Must be able to analyse the energy system of a building and apply in practice different fault detection tools
- Must be able to rank, prioritize and solve faults

TYPE OF INSTRUCTION

Project 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	Fault Detection and Diagnosis in Buildings
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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Detektering af fejl og diagnosticering af bygningen og dens tekniske systemer
Module code	B-IE-K3G-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	Mingzhe Liu, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Corresponding to the knowledge gained in 1st and 2nd semester or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete 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

Internship in a company and project work. The study board must approve on the content of the project work before the internship is commenced.

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	Academic Internship
Type of exam	Oral exam based on a project Oral exam based on presentation seminar and project rapport.
ECTS	30
Assessment	Passed/Not Passed
Type of grading	Internal examination

Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	B-IE-K3G-13
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	Mingzhe Liu, Rasmus Lund Jensen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge corresponding to the first three semesters of the master programme. (for long Master's Thesis this applies only to the two first semesters).

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete 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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-IE-K4G-15
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	Rasmus Lund Jensen
Time allocation for external examiners	D

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge corresponding to the first three semesters of the master programme. (for long Master's Thesis this applies only to the two first semesters).

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 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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-IE-K4G-16
Module type	Project
Duration	2 semesters
Semester	Spring
ECTS	50
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen
Time allocation for external examiners	D

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge corresponding to the first three semesters of the master programme. (for long Master's Thesis this applies only to the two first semesters).

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.

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	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-IE-K4G-17
Module type	Project
Duration	2 semesters
Semester	Spring
ECTS	45
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen
Time allocation for external examiners	D

ORGANISATION

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BUILDING COMMISSIONING AND OPERATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge corresponding to 2nd semester and knowledge gained in Control and Analysis of Building Energy Systems and Fault Detection in Buildings or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about building Commissioning and Operation
- Must have knowledge about standards and state of art within building Commissioning
- Must have knowledge about energy efficient operation of buildings.

SKILLS

- Must be able to apply commissioning processes for energy efficient building design and operation
- Must be able to apply, combine and evaluate advanced methods for analysis of the interplay between energy systems, building use, outdoor climate, HVAC systems and Building Management Systems (BEMS)
- Must be able to analyse a building with focus on operation and reduced running cost.

COMPETENCES

- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within Commissioning and Operation of building and its services
- Must be able to optimise the operation of buildings based on measurement and analysis of the performance of the building
- Must be able to handle complex cases related to Commissioning and Operation of energy efficients buildings
- 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 20 ECTS project module, the workload is expected to be 600 hours for the student.

EXAM

EXAMS

Name of exam	Building Commissioning and Operation
Type of exam	Oral exam based on a project

	Individual oral exam based on presentation seminar and project rapport.
ECTS	20
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Bygningens ibrugtagning og drift
Module code	B-IE-K3G-9
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Mingzhe Liu, Rasmus Lund Jensen

ORGANISATION

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Faculty	Faculty of Engineering and Science

ADVANCED MODELLING OF ENERGY TRANSPORT IN BUILDINGS AND HVAC SYSTEMS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objective:

Students who complete the module:

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to describe the mathematical models for the dynamic conditions of buildings and HVAC systems
- Must be able to explain the analytic and/or numerical solutions of these models
- Must be able to understand how building models and HVAC system models are combined and interact

SKILLS

- Must be able to analyse and simulate a thermal system under varying load conditions
- Must be able to apply both simple and advanced calculation methods for analysis and simulation of temperature conditions and heat flows in buildings and elements in HVAC systems under dynamic load conditions
- Must be able to apply experimental methods for verification of the calculated systems
- Must be able to establish proper boundary conditions comprising heat conduction, radiation and convection

COMPETENCES

- Must be able to evaluate, optimise and combine models for energy transport in buildings and HVAC systems
- 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 20 ECTS project module, the workload is expected to be 600 hours for the student.

EXAM

EXAMS

Name of exam	Advanced Modelling of Energy Transport in Buildings and HVAC Systems
Type of exam	Oral exam based on a project Individual oral exam based on presentation seminar and project rapport.
ECTS	20
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf

FACTS ABOUT THE MODULE

Danish title	Avanceret modellering af energitransport i bygninger og VVS installationer
Module code	B-IE-K3G-10
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	Danish and English
Location of the lecture	Campus Aalborg
Responsible for the module	Mingzhe Liu, Rasmus Lund Jensen

ORGANISATION

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