



AALBORG UNIVERSITET

# **CURRICULUM FOR THE MASTER'S PROGRAMME IN BUILDING ENERGY DESIGN, 2018**

MASTER OF SCIENCE (MSC) IN TECHNOLOGY  
AALBORG

MODULES INCLUDED IN THE CURRICULUM

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# BYGNINGENS ENERGIFORBRUG OG INDEKLIMA

2018/2019

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Introduction to Problem Based Learning and models in the build environment.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must be able to understand methods to evaluate the interplay between the indoor environment, heat and moisture transport and energy consumption of a building
- Must have knowledge of essential standards within indoor environment and energy

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to apply proper terminology
- Must be able to carry out dimensioning of the building envelope regarding moisture
- Must be able to apply methods to analyse the interplay between the indoor environment, heat and moisture transport
- Must be able to analyse the building envelope in order to minimize the energy consumption
- Must be able to carry through and document energy calculation on a professional level
- Must be able to utilize Building Information Models (BIM) and account for key aspects regarding model co-operation during the design process

#### KOMPETENCER

Students who complete the module:

- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within indoor environment and building energy
- 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

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 15 ECTS which is corresponding to 450 hours of study.

#### EKSAMEN

#### PRØVER

Prøvens navn	Bygningens energiforbrug og indeklima
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Prøveform	Mundtlig pba. projekt
ECTS	15
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Building Energy Use and Indoor Environmental Quality
Modulkode	B-BED-K1-1
Modultype	Projekt
Varighed	1 semester
Semester	Forår
ECTS	15
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Olena Kalyanova Larsen</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# INTRODUKTION TIL PROBLEMBASERET LÆRING OG MODELLER I DET BYGGEDE MILJØ

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Corresponding to the admission requirement.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must have knowledge and understanding of project organized problem-based learning
- Must have knowledge about group work/conflicts and ways to solve conflicts
- Must have knowledge and comprehension of planning and structuring the documentation of a project
- Must have knowledge about models within the built environment

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to apply the project organized learning to actual problem related work in groups
- Must be able to apply systematic methods
- Must be able to apply models within the built environment to problems within the relevant technical area
- Must be able to define goals for the project work and write a conclusion that answers the problem formulation of the project
- Must be able to describe and analyse one or more approaches to the project
- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within relevant technical areas

#### KOMPETENCER

Students who complete the module:

- Independently be able to define and analyse scientific problems
- Must be able to establish, evaluate and reflect on models within the built environment on the essential problems within relevant technical areas
- 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

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Introduktion til problembaseret læring og modeller i det byggede miljø
Prøveform	Mundtlig pba. projekt
ECTS	5
Bedømmelsesform	Bestået/ikke bestået
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

### FAKTA OM MODULET

Engelsk titel	Introduction to Problem Based Learning and Models in the Built Environment
Modulkode	B-BED-K1-2
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Olena Kalyanova Larsen</a>

### ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# INTRODUKTION TIL BYGGERIETS INFORMATIONSHÅNDTERING

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Corresponding to the admission requirements.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must have knowledge and understanding of project organized problem-based learning
- Must have knowledge about group work/conflicts and ways to solve conflicts
- Must have knowledge and comprehension of planning and structuring the documentation of a project
- Must have knowledge about models within the built environment

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to apply the project organized learning to actual problem related work in groups
- Must be able to apply systematic methods
- Must be able to apply models within the built environment to problems within the relevant technical area
- Must be able to define goals for the project work and write a conclusion that answers the problem formulation of the project
- Must be able to describe and analyse one or more approaches to the project
- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within relevant technical areas

#### KOMPETENCER

Students who complete the module:

- Independently be able to define and analyse scientific problems
- Must be able to establish, evaluate and reflect on models within the built environment on the essential problems within relevant technical areas
- 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

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Introduktion til byggeriets informationshåndtering
Prøveform	Skriftlig eller mundtlig
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

### FAKTA OM MODULET

Engelsk titel	Introduction to Building Information Management
Modulkode	B-BED-K1-3
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Olena Kalyanova Larsen</a>

### ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet



# ENERGISIMULERING AF BYGNINGER

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Corresponding to the admission requirements

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must have knowledge of heat balance of buildings
- Must be able to understand heat and moisture transfer in the building envelope
- Must be able to account for the hygro thermal functional demands regarding materials and constructions used in the building envelope
- Must have knowledge of calculation methodology for building energy use
- Must have knowledge of legislation requirements regarding building energy use
- Must have knowledge of numerical solutions of mathematical problems

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to set up hygro thermal functional requirements regarding the building envelope and materials
- Must be able to size the building envelope according to hygro thermal functional demands
- Must be able to conduct a blower door test of a building
- Must be able to set up a steady state heat balance for a building including in and external loads
- Must be able to document the building energy requirements using appropriate methods
- Must be able to perform dynamic simulation of heat flows in building using building energy simulation tools

#### KOMPETENCER

Students who complete the module:

- Independently be able to define and analyse scientific problems
- Must be able to apply proper terminology in oral, written and graphical communication and documentation of problems and solutions within sizing the building envelope
- Be able to qualitative quantify the importance of boundary condition, user behaviour and detail level of mathematical models to estimate energy use and indoor environment
- Must be able to discuss and evaluate the preconditions and results of building energy use

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Energisimulering af bygninger
Prøveform	Skriftlig eller mundtlig Individual oral or written examination.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	As stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Building Heat, Moisture and Energy Modelling
Modulkode	B-BED-K1-4
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Olena Kalyanova Larsen</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# BYGNINGENS VENTILATION OG INSTALLATIONER

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 1st semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must be able to understand the principles and theories behind planning of HVAC systems
- Must be able to apply methods to analyse the interplay between the indoor environment energy use and HVAC systems
- Must have knowledge of economic calculation of profitability including overall economy consequences of indoor related productivity changes
- Must have knowledge of key standards within building information modelling in the field of HVAC systems

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to apply proper terminology
- Must be able to set up functional demands to the indoor environment and HVAC systems of a building
- Must be able to measure the indoor environmental quality and energy consumption of a building and its systems
- Must be able to design the HVAC systems based on an overall consideration to ensure fulfilment of the building code
- Must be able to analyse the building to minimize the energy use by optimizing the HVAC systems and indoor environment level
- Must be able to analyse the financial profitability of the HVAC solution and the entire building design
- Must be able to use BIM in designing and quality assurance of the HVAC systems

#### KOMPETENCER

Students who complete the module:

- Must be able to size the indoor environment and HVAC system of a building
- Must be able to argue for the chosen HVAC system in relation to the level of indoor environment to all parties in the building sector
- 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

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 15 ECTS which is corresponding to 450 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Bygningens ventilation og installationer
Prøveform	Mundtlig pba. projekt Oral exam based on presentation seminar and project rapport.
ECTS	15
Bedømmelsesform	7-trins-skala
Censur	Ekstern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

### FAKTA OM MODULET

Engelsk titel	Building Ventilation, Heating and Cooling
Modulkode	B-BED-K2-5
Modultype	Projekt
Varighed	1 semester
Semester	Efterår
ECTS	15
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Michal Zbigniew Pomianowski</a>
Censornorm	B

### ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# ANALYSE OG MÅLING AF INDEKLIMA

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 1st semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must have knowledge of functional demands regulatory requirements and standards regarding sizing and measuring the indoor environment
- Must have basic knowledge of the factors influencing the indoor environment and be able to assess the importance of the individual factors importance including adaptive comfort and productivity
- Must have knowledge about measuring and calibration technique within indoor environment and building energy

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to conduct an analyse of the interplay between the indoor environment and building energy use
- Must be able to set up functional requirements for the indoor environment
- Must be able to assess the indoor environment according to comfort productivity and energy use
- Must be able to perform relevant measurements of the indoor environment and building energy use

#### KOMPETENCER

Students who complete the module:

- Must be able to participate in a dialogue regarding optimal choice of indoor environment level compared to building type and use
- Must be able to argue for the chosen level of indoor environment to all parties in the building sector
- Must be able to evaluate and reflect on the measured indoor environment and energy use including the used experimental methods and uncertainty of the measurements

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Analyse og måling af indeklima
Prøveform	Mundtlig pba. projekt

	Individual oral exam based on presentation seminar and project rapport.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Indoor Environmental Analysis and Measurements
Modulkode	B-BED-K2-6
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Michal Zbigniew Pomianowski</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# VENTILATIONSTEKNIK

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 1st semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must be able to account for the functional requirements regarding comfort in relation to ventilation
- Must have knowledge about the terminology within ventilation
- Must have knowledge on current standards and regulations within comfort ventilation
- Must be able to understand the theory on mixing and displacement ventilation
- Must have knowledge on natural and hybrid ventilation
- Must have knowledge on design and balancing of duct systems
- Must have knowledge on choice of components for the ventilation unit
- Must have knowledge on noise in relation to ventilation
- Must be able to account in general for the control of ventilation systems
- Must have knowledge on the energy consumption of the individual parts of the ventilation unit
- Must have knowledge on the workflow of a ventilation contract including commissioning and maintenance

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to make a reasoned choice of ventilation principle and system based on the functional requirements and relevant loads
- Must be able to equip and size a ventilation system based on performance requirements
- Must be able to perform an impact assessment regarding the energy use of the system and its components
- Must be able to size a ventilation system based on noise requirements

#### KOMPETENCER

Students who complete the module:

- Must be able to reflect on the chosen ventilation solution in relation to functional demands and loads
- Must be able to discuss and evaluate the optimal choice of ventilation in relation to outdoor and indoor conditions, users and the building

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Ventilationsteknik
Prøveform	Mundtlig pba. projekt Individual oral exam based on presentation seminar and project rapport.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Building Ventilation
Modulkode	B-BED-K2-7
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Michal Zbigniew Pomianowski</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet



# VARME- OG KØLETEKNIK

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 1st semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- Must understand the basics of water and airflows
- Must understand the physical properties and characteristics of liquids and gases
- Must have knowledge on functional requirements regulations and standards regarding heating and cooling systems
- Must be able to account in general for the system layout and control of heating and cooling systems
- Must be able to explain pressure distribution closed pipe systems
- Must have knowledge on sizing heating and cooling systems

#### FÆRDIGHEDER

Students who complete the module:

- Must be able to calculate the hydrostatic forces
- Must be able to apply the continuity energy and momentum equations
- Must be able to set up functional requirements for heating and cooling systems
- Must be able to size heating and cooling systems
- Must be able to carry out calculation of pressure losses for closed duct systems including pumps
- Must be able to describe the control of the heating system

#### KOMPETENCER

Students who complete the module:

- Must be able to evaluate different system designs according to a specific building the energy consumption future-orientated maintenance and security of supplies
- Must be able to discuss and evaluate the optimal choice of heating and cooling systems

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

#### EKSAMEN

#### PRØVER

Prøvens navn	Varme- og køleteknik
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Prøveform	Mundtlig pba. projekt Individual oral exam based on presentation seminar and project rapport.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Heating and Cooling Systems
Modulkode	B-BED-K2-8
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Michal Zbigniew Pomianowski</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# **BYGNINGENS IBRUGTAGNING DRIFT OG MILJØPÅVIRKNING**

**2018/2019**

## **FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET**

The module is based upon knowledge obtained at the 2nd semester or equivalent

## **MODULETS INDHOLD, FORLØB OG PÆDAGOGIK**

### **LÆRINGSMÅL**

#### **VIDEN**

Students who complete the module:

- Must have knowledge about building Commissioning Operation and Environmental impact
- 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, building services and running cost
- Must be able to understand the interplay between microclimate, buildings and operation of their services
- Must be able to understand the interplay between sustainable energy system, building energy demand and renewable energy production

#### **FÆRDIGHEDER**

Students who complete the module:

- Must be able to apply and combine design methods 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, architectural concepts, building design, building use, outdoor climate and HVAC systems
- Must be able to design a building with focus on operation and reduced running cost

#### **KOMPETENCER**

Students who complete the module:

- 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 optimise the operation of buildings based on measurement and analysis of the performance of the building
- Must be able to handle complex and research-oriented cases related to development of and running energy efficient 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

#### **UNDERVISNINGSFORM**

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

#### **OMFANG OG FORVENTET ARBEJDSINDSAT**

The module is 15 ECTS which is corresponding to 450 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Bygningens ibrugtagning drift og miljøpåvirkning
Prøveform	Mundtlig pba. projekt Oral exam based on presentation seminar and project rapport.
ECTS	15
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Building Commissioning Operation and Environmental Impact
Modulkode	B-BED-K3-9
Modultype	Projekt
Varighed	1 semester
Semester	Forår
ECTS	15
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Anna Joanna Marszal-Pomianowska</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# STYRING OG ANALYSE AF BYGNINGERS ENERGISYSTEMER

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 2nd semester or equivalent

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- 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

#### FÆRDIGHEDER

Students who complete the module:

- 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

#### KOMPETENCER

Students who complete the module:

- 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

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Styring og analyse af bygningers energisystemer
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Prøveform	Skriftlig eller mundtlig Individual oral or written exam. Exam format is decided on by start of semester.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Control and Analysis of Building Energy Systems
Modulkode	B-BED-K3-10
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Anna Joanna Marszal-Pomianowska</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# KANDIDATSPECIALE

**2018/2019**

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

The master's thesis can be conducted as a long master's thesis of 45 ECTS. If choosing to do a long master's 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-credits.

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- 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

#### FÆRDIGHEDER

Students who complete the module:

- 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 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

#### KOMPETENCER

Students who complete the module:

- 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
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility
- Must be able to communicate the results of the project work in a project report

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 30 ECTS which is corresponding to 900 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Kandidatspeciale
Prøveform	Speciale/afgangsprojekt Oral exam based on presentation seminar and project rapport.
ECTS	30
Bedømmelsesform	7-trins-skala
Censur	Ekstern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Master's Thesis
Modulkode	B-BED-K4-15
Modultype	Projekt
Varighed	1 semester
Semester	Forår
ECTS	30
Undervisningsprog	Dansk og engelsk
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a>
Censornorm	D

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet



# KANDIDATSPECIALE

**2018/2019**

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

The master's thesis can be conducted as a long master's thesis of 45 ECTS. If choosing to do a long master's 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-credits.

### LÆRINGSMÅL

#### VIDEN

Students who complete the module:

- 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

#### FÆRDIGHEDER

Students who complete the module:

- 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 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

#### KOMPETENCER

Students who complete the module:

- 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
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility
- Must be able to communicate the results of the project work in a project report

#### UNDERVISNINGSFORM

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

#### OMFANG OG FORVENTET ARBEJDSINDSATS

The module is 45 ECTS which is corresponding to 1350 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Kandidatspeciale
Prøveform	Speciale/afgangsprojekt Oral exam based on presentation seminar and project rapport.
ECTS	45
Bedømmelsesform	7-trins-skala
Censur	Ekstern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Master's Thesis
Modulkode	B-BED-K4-16
Modultype	Projekt
Varighed	1 semester
Semester	Forår
ECTS	45
Undervisningsprog	Engelsk
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a>
Censornorm	D

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# **BÆREDYGTIGE VURDERINGSMETODER OG LCC ANALYSE**

**2018/2019**

## **FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET**

The module is based upon knowledge obtained at the 2nd semester or equivalent.

## **MODULETS INDHOLD, FORLØB OG PÆDAGOGIK**

### **LÆRINGSMÅL**

#### **VIDEN**

Students who complete the module:

- Must have knowledge about the design philosophy and calculation methods which can be used to minimize 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, 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 Life Cycle Cost (LCC) analysis
- Must have knowledge about Cost Optimization

#### **FÆRDIGHEDER**

Students who complete the module:

- Must be able to perform a Life Cycle Assessment (LCA) of a building
- Must be able to evaluate buildings by using assessment and certification methods for high performance buildings
- Must be able to perform a Life Cycle Cost (LCC) analysis of a building
- Must be able to automate basic cost optimisation

#### **KOMPETENCER**

Students who complete the module:

- 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 LCA, LCC Analysis and Cost Optimization
- Must be able to discuss and reflect on the prospects and limitations of LCC Analysis and Cost Optimization

#### **UNDERVISNINGSFORM**

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

#### **OMFANG OG FORVENTET ARBEJDSINDSATS**

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Bæredygtige vurderingsmetoder og LCC analyse
Prøveform	Skriftlig eller mundtlig Individual oral or written exam. Exam format is decided on by start of semester.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Environmental Assessment Methods and LCC Analysis
Modulkode	B-BED-K3-11
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Anna Joanna Marszal-Pomianowska</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# ENERGIPRODUCERENDE OG -OMFORMENDE SYSTEMER

2018/2019

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 2nd semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

- Must have knowledge about functional requirements and how to estimate load profiles
- Must have knowledge about renewably energy systems in buildings
- Must have knowledge about the construction and principle of operation of solar collectors and photovoltaic systems
- Must have knowledge about thermodynamic cycle in heat pumps and refrigeration cycle of compressors
- Must be able to understand the interplay between different types of energy storage, heat pump systems and typical heating and cooling systems in buildings

#### FÆRDIGHEDER

- Must be able to set up functional requirements and load profiles
- Must be able to apply methods to calculate sun path and shade
- Must be able to apply methods to sizing of solar heat, photovoltaic, heat pumps and refrigeration systems

#### KOMPETENCER

- Must be able to evaluate and reflect on the relevance of the individual energy systems in relation to a specific building and its expected energy use
- Must be able to discuss with peers on the proper choice of different types of energy systems

#### UNDERVISNINGSFORM

Lectures and exercises in groups supplemented with e.g. workshops, presentation seminars and more.

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Energiproducerende og -omformende systemer
Prøveform	Skriftlig eller mundtlig Individual oral or written exam. Exam format is decided on by start of the semester.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve

Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>
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## FAKTA OM MODULET

Engelsk titel	Energy Producing and Energy Converting System
Modulkode	B-BED-K3-12
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Anna Joanna Marszal-Pomianowska</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

# INTEGRERET ENERGIDESIGN AF BYGNINGER

**2018/2019**

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module is based upon knowledge obtained at the 2nd semester or equivalent.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

- 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 buoyancy driven flows in single zone modelling
- Describe the mathematical models for multizone modelling

#### FÆRDIGHEDER

- 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

#### KOMPETENCER

- 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

#### UNDERVISNINGSFORM

Lectures and exercises in groups supplemented with e.g. workshops, presentation seminars and more.

#### OMFANG OG FORVENTET ARBEJDSINDSAT

The module is 5 ECTS which is corresponding to 150 hours of study.

## EKSAMEN

### PRØVER

Prøvens navn	Integrated Building Energy Design
Prøveform	Skriftlig eller mundtlig Individual oral or written exam. Exam format is decided on by start of the semester.
ECTS	5

Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Are stated in the Joint Programme Regulations. <a href="http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf">http://www.engineering.aau.dk/digitalAssets/332/332984_faellesbestemmelser_230617.pdf</a>

## FAKTA OM MODULET

Engelsk titel	Integrated Building Energy Design
Modulkode	B-BED-K3-13
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Undervisningssted	Campus Aalborg
Modulansvarlig	<a href="#">Rasmus Lund Jensen</a> , <a href="#">Anna Joanna Marszal-Pomianowska</a>

## ORGANISATION

Studienævn	Studienævnet for Byggeri og Anlæg
Institut	Institut for Byggeri og Anlæg
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet