AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN (CAND.TECH) I BYGNINGERS ENERGIDESIGN, 2021

CAND.TECH.
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

BUILDING ENERGY USE AND INDOOR ENVIRONMENTAL QUALITY

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

It is recommended to have completed the course Introduction to Problem Based Learning and models in the build environment.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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 end 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

LEARNING OBJECTIVES FOR PROBLEM BASED LEARNING

- Must be able to apply problem solving
- Must be able to use problem identification
- Must be able to apply objectives (cooperation agreement)
- Must be able to use contextual involvement (user involvement)
- Must be able to analyse teamwork/team composition
- Must have knowledge of process analysis
- Must be able to use problem formulation
- Must be able to assess meetings/scheduling of meetings
- Must be able to analyse time planning
- Must be able to apply problem analysis
- Must be able to analyse personal competencies and wishes
- Must be able to assess problem solving
- Must be able to apply project management

- Must be able to apply impact assessment

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Building Energy Use and Indoor Environmental Quality
Type of exam	Oral exam based on a project
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	Bygningens energiforbrug og indeklima
Module code	B-BED-K1-6
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen, Olena Kalyanova Larsen

ORGANISATION

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

INTRODUCTION TO PROBLEM BASED LEARNING AND MODELS IN THE BUILT ENVIRONMENT

2022/2023

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Introduction to Problem Based Learning and Models in the Built Environment

Type of exam	Written or oral 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	Introduktion til problembaseret læring og modeller i det byggede miljø
Module code	B-BED-K1-7
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	Rasmus Lund Jensen, Olena Kalyanova Larsen

ORGANISATION

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

INTRODUCTION TO BUILDING INFORMATION MANAGEMENT

2022/2023

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Introduction to Building Information Management

Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Introduktion til byggeriets informationshåndtering
Module code	B-BED-K1-8
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	Rasmus Lund Jensen, Olena Kalyanova Larsen

ORGANISATION

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

BUILDING HEAT, MOISTURE AND ENERGY MODELLING 2022/2023

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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
- Must 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 discus and evaluate the preconditions and results of building energy use

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Building Heat, Moisture and Energy Modelling
Type of exam	Written or oral exam

ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Energisimulering af bygninger
Module code	B-BED-K1-9
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	Rasmus Lund Jensen, Olena Kalyanova Larsen

ORGANISATION

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

BUILDING VENTILATION, HEATING AND COOLING

2021/2022

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

LEARNING OBJECTIVES FOR PROBLEM BASED LEARNING

- Must be able to assess problemsolving
- Must be able to assess teamwork/team composition
- Must be able to understand and explain what process analysis is
- Must be able to assess impact assessment

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- An approved PBL competency profile is a prerequisite for participation in the project exam.

EXAMS

Name of exam	Building Ventilation, Heating and Cooling
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	Bygningens ventilation og installationer
Module code	B-BED-K2-9
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	Rasmus Lund Jensen, Michal Zbigniew Pomianowski
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

INDOOR ENVIRONMENTAL ANALYSIS AND MEASUREMENTS

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Indoor Environmental Analysis and Measurements
Type of exam	Written or oral exam

ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Analyse og måling af indeklima
Module code	B-BED-K2-10
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	Rasmus Lund Jensen, Michal Zbigniew Pomianowski

ORGANISATION

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

BUILDING VENTILATION

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

Students who complete the module:

- Must be able to make an 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 base 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

COMPETENCES

Students who complete the module:

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Building Ventilation
Type of exam	Written or oral 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	Ventilationsteknik
Module code	B-BED-K2-11
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	Rasmus Lund Jensen, Michal Zbigniew Pomianowski

ORGANISATION

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

HEATING AND COOLING SYSTEMS

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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 discus and evaluate the optimal choice of heating and cooling systems

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Heating and Cooling Systems
Type of exam	Written or oral 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	Varme- og køleteknik
Module code	B-BED-K2-12
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	Rasmus Lund Jensen, Michal Zbigniew Pomianowski

ORGANISATION

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

BUILDING COMMISSIONING OPERATION AND ENVIRONMENTAL IMPACT

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Building Commissioning Operation and Environmental Impact
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	Bygningens ibrugtagning drift og miljøpåvirkning
Module code	B-BED-K3-9
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen, Anna Marszal-Pomianowska

ORGANISATION

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

CONTROL AND ANALYSIS OF BUILDING ENERGY SYSTEMS

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Control and Analysis of Building Energy Systems
Type of exam	Written or oral 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	Styring og analyse af bygningers energisystemer
Module code	B-BED-K3-14
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	Rasmus Lund Jensen, Anna Marszal-Pomianowska

ORGANISATION

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

MASTER'S THESIS

2022/2023

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

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

ADDITIONAL INFORMATION

The Master's thesis must include an English summary.* If the project is written in English, the summary can be in Danish. The summary must be at least 1 page and not more than 2 pages. The summary is included in the evaluation of the project as a whole.

* Or another foreign language (upon approval from the Board of Studies).

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-BED-K4-15
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	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 Built Environment
Department	Department of the Built Environment
Faculty	The Faculty of Engineering and Science

MASTER'S THESIS

2022/2023

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

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.

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

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

ADDITIONAL INFORMATION

The Master’s thesis must include an English summary.* If the project is written in English, the summary can be in Danish. The summary must be at least 1 page and not more than 2 pages. The summary is included in the evaluation of the project as a whole.

* Or another foreign language (upon approval from the Board of Studies).

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	B-BED-K4-16
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	45
Language of instruction	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 Built Environment
Department	Department of the Built Environment
Faculty	The Faculty of Engineering and Science

ENVIRONMENTAL ASSESSMENT METHODS AND LCC ANALYSIS

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

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

SKILLS

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

COMPETENCES

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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Environmental Assessment Methods and LCC Analysis
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Bæredygtige vurderingsmetoder og LCC analyse
Module code	B-BED-K3-15
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	Rasmus Lund Jensen, Anna Marszal-Pomianowska

ORGANISATION

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

ENERGY PRODUCING AND ENERGY CONVERTING SYSTEM

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module:

- 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

SKILLS

Students who complete the module:

- 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

COMPETENCES

Students who complete the module:

- 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

TYPE OF INSTRUCTION

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Energy Producing and Energy Converting System
Type of exam	Written or oral exam
ECTS	5

Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Energiproducerende og -omformende systemer
Module code	B-BED-K3-16
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen, Anna Marszal-Pomianowska

ORGANISATION

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

INTEGRATED BUILDING ENERGY DESIGN

2022/2023

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

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

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module:

- 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

Students who complete the module:

- 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

Students who complete the module:

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

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Integrated Building Energy Design

Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Integreret energidesign af bygninger
Module code	B-BED-K3-17
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Rasmus Lund Jensen, Anna Marszal-Pomianowska

ORGANISATION

Study Board	Study Board of Built Environment
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