



Curriculum for the Master's Programme in Construction Management and Building Informatics

Aalborg University
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Preface

Pursuant to Act 261 of March 18, 2015 on Universities (the University Act) with subsequent changes, the following curriculum is established. The programme also follows the Joint Programme Regulations and the Examination Policies and Procedures for The Faculty of Engineering and Science, The Faculty of Medicine and The Technical Faculty of IT and Design.

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Chapter 1: Legal Basis of the Curriculum etc.

1.1 Basis in Ministerial Orders

The Master's programme is organised in accordance with the Ministry of Higher Education and Science's Order no. 1328 of November 15, 2016 on Bachelor's and Master's Programmes at Universities (the Ministerial Order of the Study Programmes) with subsequent changes and Ministerial Order no. 1062 of June 30, 2016 on University Examinations (the Examination Order). Further reference is made to Ministerial Order no. 111 of January 30, 2017 (the Admission Order) and Ministerial Order no. 114 of February 3, 2015 (the Grading Scale Order) with subsequent changes.

1.2 Faculty affiliation

The Master's programme falls under the Faculty of Engineering and Science, Aalborg University.

1.3 Board of Studies affiliation

The Master's programme falls under the Board of Studies for Civil Engineering, School of Engineering and Science.

1.4 External Examiners Corps

The Master's programme is associated with Ingeniøruddannelsernes Landsdækkende Censorkorps – bygningsretningen.

Chapter 2: Admission, Degree Designation, Program Duration and Competence Profile

2.1 Admission

Applicants with a legal right of admission (retskrav):

Aalborg University offers no bachelor's programmes with a legal right of admission to this Master's programme.

Applicants without legal right of admission:

Bachelor's programmes qualifying students for admission:

- Bygningskonstruktør / Bachelor's degree in Architectural Technology and Construction Management, *University College Nordjylland; VIA University College; Københavns Erhvervsakademi; Erhvervsakademiet Lillebælt; Erhvervsakademi Sjælland and Erhvervsakademi Sydvest*
- Bachelor of Science in Civil Engineering, Aalborg University
- Bachelor of Engineering (Civil Engineering), Aalborg University
- Bachelor of Science in Engineering (Architecture and Design with specialization in Architecture and Urban Design), Aalborg University
- Bachelor of Science in Architectural Engineering, Technical University of Denmark
- Bachelor of Engineering in Architectural Engineering, Technical University of Denmark
- Bachelor of Engineering in Civil Engineering, Technical University of Denmark
- Bachelor of Engineering in Architectural Engineering, Aarhus University
- Bachelor of Engineering in Civil and Structural Engineering, Aarhus University
- Bachelor of Engineering in Civil Engineering, VIA University College, Horsens

Students with another Bachelor degree may, upon application to the Board of Studies, be admitted following a specific academic assessment if the applicant is considered as having comparable educational prereq-

uisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree designation in Danish and English

The programme entitles the graduate to the designation cand.tech. (candidatus/candidata technologiae) i byggeledelse og bygningsinformatik med specialisering i byggeledelse *eller* cand.tech. (candidatus/candidata technologiae) i byggeledelse og bygningsinformatik med specialisering i bygningsinformatik.

The English designation is: Master of Science (MSc) in Technology (Construction Management and Building Informatics with specialisation in Construction Management) *or* Master of Science (MSc) in Technology (Construction Management and Building Informatics with specialisation in Building Informatics).

2.3 The program's specification in ECTS credits

The Master's programme is a 2-year, research-based, full-time study program. The program is set to 120 ECTS credits.

2.4 Competence profile on the diploma

The following competence profile will appear on the diploma:

A Candidatus graduate has the following competency profile:

A Candidatus graduate has competencies that have been acquired via a course of study that has taken place in a research environment.

A Candidatus graduate is qualified for employment on the labour market on the basis of his or her academic discipline as well as for further research (PhD programmes). A Candidatus graduate has, compared to a Bachelor, developed his or her academic knowledge and independence so as to be able to apply scientific theory and method on an independent basis within both an academic and a professional context.

2.5 Competence profile of the programme

Students following the programme can chose between two specialisations in *Construction Management* and *Building Informatics*. The competence profile consists of:

1. Common profile for the two specialisations
2. Specific profile for *Construction Management*
3. Specific profile for *Building Informatics*

2.5.1. Common profile:

Knowledge:

- Has knowledge in construction management and ICT supported collaborative processes in the building industry that, in selected areas, are based on the highest international research
- Can understand and, on a scientific basis, reflect on the knowledge of management and informatics in the building industry and identify scientific problems.

Skills:

- Can communicate research-based knowledge and discuss profes-

sional and scientific problems with both peers and non-specialists.

- Can evaluate and select among the scientific theories, methods, tools and general skills within the AEC industry and, on a scientific basis, contribute to new analyses and solutions.

Competences:

- Can manage work and development situations that are complex, unpredictable and require new solutions.
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility.
- Can independently take responsibility for own professional development and specialisation.
- Can structure and communicate problems and solutions and consequences targeted at different recipients and consider both professional, technical ethics as a possible conflict of interests.

2.5.2. Specific for specialisation in Construction Management:

Knowledge:

- Has knowledge about organisation and management of order-based production in the building activity, including management systems, both technical, economic, social and organisational.
- Can understand and, on a scientific basis, reflect over the builders' and construction contractors' frames and conditions for production, and be able to identify innovation and development potentials.

Skills:

- Can make use of scientific methods, tools and general skills related to employment within Management in the Building Industry.

Competences:

- Can manage building projects from soil work through construction to the complete building.
- Can manage building projects in compliance with legal Danish requirements.

2.5.3. Specific for specialisation in Building Informatics:

Knowledge:

- Has knowledge of the AEC industry including organization and information needs as well as systems used for modelling and information exchange in the collaboration between different professional disciplines.
- Has knowledge of the formulation of user needs and requirements and the development of ICT-supported systems for collaboration and communication in the design, construction and operation process.

Skills:

- Can analyse construction industry business processes and identify user needs and system requirements related to information management
- Can propose solutions for information management including choice of data models, organisation and specific tools within 3D modelling, analysis and visualization of results

Competences:

- Can contribute to added value of ICT systems in the construction industry by bridging the gap between software developers, system suppliers and end users of the systems.
- Can take part in decisions regarding development, purchase and implementation of information systems for the construction industry from operational to strategic level.

Chapter 3: Content and Organisation of the Programme

The programme is structured in modules and organised as a problem-based study. A module is a programme element or a group of programme elements, which aims to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluding with one or more examinations within specific exam periods.

The programme is based on a combination of academic, problem-oriented and interdisciplinary approaches and organised based on the following work and evaluation methods that combine skills and reflection:

- project work
- lectures
- classroom instruction
- study circles
- workshops
- exercises (individually and in groups)
- laboratory experiments
- field measurements and registration
- portfolio work
- independent study

Where the modules are specific aspects of teaching methods, this will be indicated by the module description, see below.

Project modules are generally evaluated in a group based oral exam based upon a submitted report and an oral group presentation according to the Framework provisions (examination policies).

For individual written exams the study board selects among the following possibilities:

- written exam based on handed out exercises
- multiple choice
- on-going evaluation of written assignments

For individual oral exams the study board selects among the following possibilities:

- oral exam with or without preparation
- oral exam based on project report
- oral exam based on presentation seminar
- portfolio based oral exam

If the number of students following a module is small and/or if the number of students having to attend a re-exam is small the study board can decide that an exam is conducted either as an oral or written individual exam for practical and economic reasons. In the first case decision must be notified before the start of the teaching activity in the latter case the students must be notified when the examination date is decided.

3.1 Overview of the programme

All modules are assessed through individual grading according to the 7-point scale or Pass/Fail. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the supervisor only).

Of a total of 120 ECTS, 110 ECTS are assessed by the 7-point scale and 45 ECTS are assessed by external examination.

Semester	Module	ECTS	Assessment	Exam
1	Design and Construction of Buildings	15	7-point scale	Internal
	Project Management and Economics	5	7-point scale	Internal
	Introduction to Building Information Management	5	7-point scale	Internal
	Introduction to Problem Based Learning and Models in the Built Environment	5	Pass/no-pass	Internal
2 Construction Management	Project Management and Production in Construction	15	7-point scale	External
	Management of the Construction Process	5	7-point scale	Internal
	Framework Conditions of Construction	5	7-point scale	Internal
	Geotechnics and Foundation	5	7-point scale	Internal
2 Building Informatics	Virtual Buildings and Data Models	15	7-point scale	External
	Management of the Construction Process	5	7-point scale	Internal
	IT System Development	5	7-point scale	Internal
	Knowledge Management in the AEC Industry	5	7-point scale	Internal
3*	A: Management of Construction Industry Companies	15	7-point scale	Internal
	B: ICT Supported Collaboration and User Involvement in the Building Process	15	7-point scale	Internal
	Implementation of IT-based Systems in Organisations	5	7-point scale	Internal
	Development of Project, Risk and Quality Management Systems in Construction	5	Pass/no-pass	Internal
	Strategy and Performance Measurements	5	7-point scale	Internal
4	Master's Thesis	30	7-point scale	External
Total		120		

* On the 3rd semester, the students can choose module A or B.

The students are given options in the project modules as they can select among different projects within the same general theme. Moreover, the Master's Thesis on the 4th semester can be selected freely within the field of Management in the Building Industry.

The Study Board of Civil Engineering can decide, that the contents of a course module on a semester is taught in the project module in the same semester, by increasing the ECTS extend as well as the learning goals. The decision is taken regarding to capacity and/or economy of the semester.

3.2 Module descriptions

1st semester

Design and Construction of Buildings (P)

Projektering og udførelse af bygningskonstruktioner

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge - The student should have knowledge within the following areas:

- The interaction between design and construction of buildings.
- Processes, organization and supporting systems related to Architecture, Engineering and Construction (AEC)
- IT systems to support the design and construction processes.

Skills – The student should be able to:

- Explain fundamental processes and their relations in design and construction of buildings
- Describe a project organization including professional disciplines and legal relations between the parties in the construction project appropriate for management of the project.
- Explain the composition of selected functional systems of the building.
- Describe properties of ICT systems to support collaboration among the disciplines including systems for building modeling
- Analyze the time required for a construction project and set schedules
- Analyze the cost of construction of a building project and plan tender calculations in regards to the chosen construction methods.
- Analyze requirements and design a site that is appropriate for the building project.
- Explain the process that the semester group has gone through.
- Document project work and its results in a well-structured report.
- Plan and carry out a presentation of the project.

Competencies

- The student can critically review the organization of the design and construction processes regarding responsibilities, agreements, project organization and the relationship between sub-processes.
- The student can take part in decisions regarding organization and supporting ICT tools in the design and construction processes based on an understanding of the technical and organizational relationships between design and execution.

Teaching methods: Project work with teacher feedback supplemented with lectures, workshops, presentation seminars and more.

Exam format: Oral examination based on presentation seminar and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

Project Management and Economics **Projektleidelse og økonomi**

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge – The student must have knowledge of the theories that describe the following areas:

- Must have knowledge of economic conditions for the construction industry
- Must have knowledge of operating, investing and financing calculations.
- Must have knowledge of budgeting and financial reporting.
- Must have knowledge of general project management models.
- Must have knowledge of basic project planning tools such as time and resource plans.
- Must have knowledge of general organizational and motivational and communication theories.
- Must have knowledge of working environment and safety and health on construction projects.

Skills

- Must be able to use the usual methods for calculation of costs in manufacturing companies.
- Must be able to use the usual methods for the assessment of investment attractiveness.
- Must be able to use the usual methods of budgeting of business operations.
- Must be able to identify and evaluate the usual sources for financing the investments and operations of a manufacturing company.
- Must be able to prepare and analyze accounts and accordingly assess the economic situation.
- Must be able to argue for usual models of motivation, communication and management and use of models in less complex cases.
- Must be able to explain the traditional models of organization of construction projects as well as classical and modern forms of cooperation in such projects.
- Must be able to design appropriate time and resource plans based on among other things the principles of "lean construction".
- Must be able to assess specific cases for the purposes of health and safety tools.

Competencies

- Must be able to explain the impact of project activities on the financial circumstances of the company as well as the managerial tasks in project management, including assignments related to organizational health and safety.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam format: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Introduction to Building Information Management **Introduktion til byggeriets informationshåndtering**

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge - The students must have knowledge of the theories that describe the following areas:

- Concepts, technologies and methods to analyze and develop models that describe a building's functional systems and components as well as processes in construction.
- Concepts, techniques and methods to develop product and process models in construction
- Methods for management of knowledge and information in construction, including different types of models and data representation.

Skills – The student must be able to:

- Explain the fundamental differences between various types of building models and process models.
- Explain central aspects of model supported collaboration between actors of the construction process.
- Demonstrate knowledge of information standards in the field, including classification systems.
- Demonstrate knowledge of significant national and international initiatives regarding the use of information technology in the construction industry.
- Explain the properties of different information representations and their suitability for modeling of different systems.

Competencies

- The course provides students with a number of basic skills to participate in the implementation of ICT-based systems in construction business.

Teaching methods: Lectures and exercises in groups supplemented with workshops, presentation seminars and more.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations

Introduction to Problem Based Learning and Models in the Built Environment
Introduktion til problembaseret læring og modeller i det byggede miljø

Objective: Students who complete the module:

Knowledge

- 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

- 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

Competencies

- 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

Exam format: Oral exam based on presentation seminar and project rapport.

Evaluation criteria: As stated in the Joint Programme Regulations.

2nd semester – Construction Management

Project management and Production in Construction (P)

Projektledeelse og produktion i byggeriet

Recommended academic prerequisites:

The module is based upon knowledge obtained in the module Project Management and Economics

Objective: Students complete the module must have acquired the following knowledge, skills and competencies:

Knowledge – The student must have knowledge of the theories that describe the following areas:

- Must have knowledge of the collection and analysis of empirical data.
- Must have knowledge of analytical methods for contracting order process.
- Must have knowledge of project management theories and methods.
- Must have knowledge of modeling processes.
- Must have knowledge of geotechnics and foundation.

Skills – The student must be able to:

- Analyze a construction order process with emphasis on design and manufacturing issues.
- Process empirical project data.
- Explain the production, quality and cost issues in the order process.
- Interpret the relationship between activities in production through the construction of whole models and detailed models that describe these conditions.
- Analyze process flows and value creation.
- Reasoning between the project and the organization's structural, technical and resource building.
- Interpret the interaction between the parties involved in a project or contract manufacturing company's various organizational units.
- Argue by using precise production-related terminology.
- Describe the alternative shapes of selective structural elements, including foundation design.

Competencies

- Must be able to assess the proposed systems and their sensitivity to changes in e.g. customer demands, regulatory, quality, etc.
- Must be able to establish operational production models. The models can be based on a deterministic, stochastic or heuristic basis.
- Must be able to assess the importance for the company or the project of changing the current situation and introduce the proposed amendment, which must be assessed from e.g. economic, organizational, social and technical consequences.
- Must be able to prepare and reflect on concrete implementation plans
- Must be able to communicate the results obtained from the project work in a project report.
- Must be able to work around the problem field project and make a joint presentation of the project results.

Teaching methods: Project work with teacher feedback supplemented with lectures, workshops, presentation seminars and more.

Exam format: Oral examination based on presentation seminar and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

Management of the Construction Process

Byggeprocessens styringsområder

Recommended academic prerequisites:

The module is based upon knowledge obtained in Project Management and Economics

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge

The course introduces the students to the various management roles in building projects and for the communication and collaboration needs which is the prerequisite for achieving effective construction process. The students must have knowledge of the theories that describe the following areas:

- Must have knowledge of management roles and management areas, including the authorities.
- Must have knowledge of proactive and reactive conflict
- Must have knowledge of basic logistics for the construction of building projects.
- Must have knowledge of quality and environmental management works carried out at construction sites.
- Must have knowledge of advanced project financial management.
- Must have knowledge of facilities management

Skills

- Must be able to compare different management roles in a construction project and relate these to the phases of the building process.
- Must be able to account for the authorities, in connection with the construction of building and construction projects
- Must be able to use various conflict resolution models.
- Must be able to integrate logistical optimization in the management of building and construction projects.
- Must be able to explain the quality and environmental management systems.
- Must be able to analyze various economic problems in building and construction projects.
- Must be able to integrate facilities management theories in the construction process.

Competencies:

- Must be able to understand the different analysis models and have a solid knowledge of the management tasks that occur during the building process.
- Must master a wide range of management areas for both large and small projects. Knowledge gained in this module must be used as skills in project management areas of logistics, economics, risk management, quality and environmental management and facilities management.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Framework Conditions of Construction

Byggeriets rammebetingelser

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge - The students must have knowledge of the theories that describe the following areas:

- Must have knowledge of national and international legislation and contractual relations in connection with the execution of building and construction works.
- Must have knowledge of work environment, including health and safety in the building and construction industry.

Skills

- Must be able to demonstrate knowledge of the use of general conditions and tender law as basic national agreement between the construction parties
- Must be able to demonstrate understanding of different performance descriptions and explain their use
- Must be able to explain the current national regulation and associated guidelines for quality assurance
- Must be able to demonstrate knowledge of general international conditions and EU tender law as basic international agreement between construction parties
- Must be able to describe national and international (EU) legislation on inviting tenders and award of contract in connection with the construction.
- Must be able to describe the building's historic development and ongoing development initiatives including OPP, partnering and use of indicators.
- Must be able to analyze the construction context in connection with general societal trends
- Must be able to use the guidelines and rules about working in construction.
- Must be able to explain labor law.

Competencies:

- Must be able to explain the framework of construction.
- Must be able to relate a given project to the framework of construction including the work environment.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Geotechnics and Foundation **Grundlæggende geoteknik og fundering**

Objective:

The course will provide an understanding of typical Danish soil types and their geotechnical properties, including characteristic material, strength and setting parameters. Geotechnics must be applied. Insight into the foundation methods, field and laboratory investigation methods must be achieved and understanding of geotechnical reports.

Knowledge

- Must have knowledge of Danish soil types and their geotechnical properties.
- Must have knowledge of field survey methods.
- Must have knowledge of laboratory testing methods.
- Must be able to understand and explain geostatic.
- Must be able to manage and account for the foundation principles of simple structures.
- Must be able to understand and explain a geotechnical report.

Skills

- Must be able to apply methods for engineering geological description of the Danish landscape and soil types.
- Must be able to use geostatic of geotechnical structures.
- Must be able to determine sentences and the critical load for simple direct-based constructions
- Must be able to assess sentences timing and assess measures against the sentences.
- Must be able to perform and assess geotechnical classification tests.
- Must be able to use geotechnical drilling profiles and geotechnical reports.

Competencies

- Must be able to use the correct terminology in geotechnics and foundation.
- Must be able to assess foundation methods in relation to Danish soil conditions.
- Must be able to assess Danish soil types and apply geotechnical reporting.

Teaching methods: Lectures supplemented with workshops, presentation seminars, laboratory visits and more.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

2nd semester – Building Informatics

Virtual Buildings and Data Models (P) Virtuelle bygninger og datamodeller

Recommended academic prerequisites:

The module is based upon knowledge obtained in 1st semester

Objective: The project will contribute to the students' knowledge and skills within building modelling and the underlying data representations. The students who complete the project should have the following knowledge, skills and competencies:

Knowledge - The students should have knowledge within the following areas:

- Building models and fundamental data models.
- Statement of requirements for the building and the relevant models.
- Modeling tools relevant for the various phases of the construction process and the lifecycle of the building including Building Information Modeling (BIM) tools.
- Organization of the construction process including the needs and requirements to data models, classification and ontologies.
- Intelligent and responsive buildings.

Skills – The student should be able to:

- Explain the principal construction, integration and use of different building product and process models.
- Explain the relationship between the different requirements to the building functional systems and models.
- Demonstrate thorough knowledge of national and international standards and initiatives related to the models and their use.
- Explain the fundamental differences between different types of data models.
- Demonstrate an overview of a representative selection of tools that can be used for modeling

Competencies- The course provides the students with a capability to:

- Advise on the specification, design and integration of product and process models in construction projects.
- Communicate the results from the project work in a project report.
- Investigate the problem thoroughly and conduct a joint presentation of results.

Teaching methods: Project work with supervision supplemented with workshops, presentation seminars and other forms of active learning.

Exam form: Oral exam based on a presentation and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

Management of the Construction Process

Byggeprocessens styringsområder

Recommended academic prerequisites:

The module is based upon knowledge obtained in the module Project Management and Economics

Objective:

Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge

The course introduces the students to the various management roles in building projects and for the communication and collaboration needs which is the prerequisite for achieving effective construction process. The students must have knowledge of the theories that describe the following areas:

- Must have knowledge of management roles and management areas, including the authorities.
- Must have knowledge of proactive and reactive conflict
- Must have knowledge of basic logistics for the construction of building projects.
- Must have knowledge of quality and environmental management works carried out at construction sites.
- Must have knowledge of advanced project financial management.
- Must have knowledge of facilities management

Skills

- Must be able to compare different management roles in a construction project and relate these to the phases of the building process.
- Must be able to account for the authorities, in connection with the construction of building and construction projects
- Must be able to use various conflict resolution models.
- Must be able to integrate logistical optimization in the management of building and construction projects.
- Must be able to explain the quality and environmental management systems.
- Must be able to analyze various economic problems in building and construction projects.
- Must be able to integrate facilities management theories in the construction process.

Competencies:

- Must be able to understand the different analysis models and have a solid knowledge of the management tasks that occur during the building process.
- Must master a wide range of management areas for both large and small projects. Knowledge gained in this module must be used as skills in project management areas of logistics, economics, risk management, quality and environmental management and facilities management.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

IT System Development
IT systemudvikling

Recommended academic prerequisites:

The module is based upon knowledge obtained in the module Introduction to Building Information Management

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge - The students should have knowledge of the theories that describe the following areas:

- IT system development.
- Object-oriented programming, visual programming and BIM
- Databases.

Skills – The student should be able to:

- Formulate specific requirements for a small-scale IT system.
- Master the basic techniques of object-oriented programming
- Develop applications by the use of a development tool/environment
- Structuring and modelling of relational databases

Competencies- The course provides the students with a capability to:

- Demonstrate a basic understanding of the software development process
- Develop small prototypes of programs.

Teaching methods: Lectures and exercises in groups supplemented with workshops, presentation seminars and other forms of active learning.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Knowledge Management in Architecture, Engineering and Construction Industry **Byggeriets videnshåndtering**

Recommended academic prerequisites:

The module is based upon knowledge obtained in the module Introduction to Building Information Management

Objective:

The student should acquire knowledge about basic concepts, technologies and methods to analyze and develop models that describe a building's functional systems, components, processes in construction and knowledge management models.

Knowledge - The students should have knowledge within the following areas:

- Knowledge representation in theory and practice including conceptual models and data models.
- Basic concepts, technologies and methods for knowledge management.
- Principles, methods and techniques for the design and evaluation of user environments for computer-aided interaction and collaboration, and knowledge exchange.
- The construction process' fundamental ontologies.

Skills – The student should be able to:

- Use various knowledge representation properties and evaluate their practical suitability for modelling of different systems.
- Document knowledge for digital delivery of building models.
- Demonstrate basic knowledge of methods and systems for ICT-supported information and knowledge sharing in the construction process including Semantic Web technologies
- Identify support systems for knowledge management
- Demonstrate how simulation and analysis systems can be integrated with building models
- Perform conceptual modelling in e.g. IDEF0, E-R and UML
- Describe how a system can be implemented in cooperation with end-users, including methods to identify user requirements and evaluation of systems under development

Competencies- The course provides the students with a capability to:

- Specify building processes and building functional systems and how these can be modeled on a conceptual and data level.

Teaching methods: Lectures and exercises in groups supplemented with workshops, presentation seminars and other forms of active learning.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

3rd semester

The student must choose either project A or B at 3rd semester.

A: Management of Construction Industry Companies (P) **Ledelsessystemer i byggeriets virksomheder**

Recommended academic prerequisites:

The module is based upon knowledge obtained in 2nd semester

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge - The students must have knowledge of the theories that describe the following areas:

- Must have knowledge of management of construction, both technical, economic, social and organizational.
- Must have knowledge of the theoretical and practical basis for the company's longer-term development.
- Must have knowledge of coherent business systems and development plans at different management levels.

Skills

- Must be able to understand the structure of different management of construction for businesses.
- Must be able to analyze business management of constructions for the improvement of companies' operating systems.
- Must be able to understand the structure of support systems for the decision makers of the company.
- Must be able to identify business needs for strategic change and develop strategic plans for this transformation.
- Must be able to identify and assess a company's need for information for budgeting and dissemination of results.

Competencies

- Must be able to be part of the management team in a construction project and in a company in the building and construction sector.
- Must be able to argue for specific strategic development initiatives and how they are implemented in practice.
- Must be able to communicate the results obtained from the project work in a project report
- Must be able to work around the project of the problem field and make a joint presentation of the project results.

Teaching methods: Project work with teacher feedback supplemented with lectures, workshops presentation seminars and more.

Exam form: Oral examination based on the presentation seminar and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

B: ICT Supported Collaboration and User Involvement in the Building Process (P)

IKT-støttet samarbejde og brugerinddragelse i byggeprocessen

Recommended academic prerequisites:

The module is based upon knowledge obtained in 2nd semester

Objective:

The project should provide the theoretical and practical background for the student to participate actively in the specification, development and testing of ICT-supported user environments for collaboration and communication.

Knowledge - The students should have knowledge within the following areas:

- Methods for user involvement in creative and innovative design of buildings within and between enterprises
- Methods for user involvement in system development
- Evaluation paradigms in system development
- Augmented, Virtual and Mixed Reality environments

Skills – The student should be able to:

- Perform specification, development and testing of ICT-supported user environments for collaboration and communication
- Identify user needs and perform system evaluation
- Use the conceptual modeling methods and system development procedures as e.g. Contextual Design
- Facilitate user-driven innovation in the construction process
- Demonstrate knowledge of the structure and properties of augmented, virtual and mixed reality systems
- Apply theories and methods for specifying user needs and system requirements
- Apply theories and methods for system evaluating
- Explain how end-users can be involved in system development

Competencies- The course provides the students with a capability to:

- Participate actively in the planning and implementation of processes, which include specification, development and testing of ICT-supported user environments and workflows for cooperation and communication between different actors.

Teaching methods: Project work with supervision supplemented with workshops, presentation seminars and other forms of active learning.

Exam form: Oral exam based on a presentation and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

Implementation of IT-based Systems in Organisations **Implementering af IT-baserede systemer i organisationer**

Objective: Students who complete the module must have acquired the following knowledge, skills, and competencies:

Knowledge - The students should have knowledge within the following areas:

- Paradigms for organizational change.
- Change management and change communication.
- Implementation of IT-based systems: Challenges related to the organizational implementation of IT-based systems from the project start to the successful implementation. The focus is on both managerial issues associated with organizational change and specific practical activities (e.g. user training).

Skills – The student should be able to:

- Demonstrate knowledge of both the managerial and practical issues associated with the implementation of IT-based systems in large organizations.
- Demonstrate knowledge within the theory of change management for IT-related change initiatives.

Competencies- The course provides the students with a capability to:

- Analyze change initiatives and develop strategies and plans for management of change related to the implementation of IT-based systems in large organizations.
- Manage organizational change processes dealing with the implementation of IT-based systems.
- Execute practical tasks associated with the introduction of new IT-based systems, including the planning and preparation of user training
- Assess and choose among scientific theories, methods, and tools for implementation of IT-based systems
- Communicate research-based knowledge and discuss professional and scientific problems in the implementation of IT-based systems with both colleagues and non-specialists

Teaching methods: Lectures and exercises in groups supplemented with workshops, presentation seminars and other forms of active learning.

Exam form: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Development of Project, Risk and Quality Management Systems in Construction
Udvikling af Kvalitets-, Risiko- og Projektstyringssystemer i Byggeri

Recommended academic prerequisites:

The module is based upon knowledge obtained in module Project Management and Economics

Objective:

Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge

The course presents the student for selected models and methods used in connection with company and project quality and project management systems. Emphasis is placed on elements targeting the company's development as a whole via tight project management.

The student must have knowledge of the theories that describe the following areas:

- Quality management - business processes and supply chain.
- Project planning and management in multi-project environments.
- Models, methods and tools for the development of advanced quality and environmental and project management systems.
- Financial management and Risk management of activities in companies with production orders and long production time.
- Project Risk management and measurement.

The course supports the students in gaining knowledge of how quality, project management and financial management systems can be included as a strategic element in the organization overall. Also how quality, project management and financial management systems can be integrated with the organization's other systems. Finally, the focus is on project risk identification and management of order-based production, including how risk management can be used as a strategic business advantage.

Skills

The student must be able to:

- Understand quality management in relation to business and project processes and analyze the organization's need for quality management with a focus on supply chain, and suggest changes and improvements to all or parts of the system.
- Understand the financial management and risk management of activities in companies with production orders. Including cash management, financial capacity management and calculations for planning and follow-up on the company's order-based production.
- Understand resource-limited project management problems and plan the execution of projects with regards to this.
- Identify and analyze risk factors for the company's project portfolio and understand risk management systems and the use of risk management for strategic purposes.
- Apply advanced methods and models to develop proposals to improve the organization's existing quality and project management systems.

Competencies

- Must be able to understand the relation between quality management, project management, and financial management and the company's other management systems and relation with suppliers and customers in the value chain.
- Must be able to apply acquired knowledge to build quality and project management systems in companies with order-based production. This is carried out in terms of how such systems interact with the company's core business and the company's other systems, particularly the company's financial management.
- Must be able to apply acquired knowledge on techniques and management systems for contract manufacturing companies.
- Must be able to apply acquired knowledge gained on how to specify projects and the challenges that may arise in project-driven businesses.
- Must be able to apply acquired knowledge gained about how companies develop quality management systems.
- Must be able to analyze risk factors for the company's project portfolio and understand risk management systems and the use of risk management in connection with the organization's strategy development process.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam format: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

Strategy and Performance Measurements

Strategi og performance measurements

Objective: Students who complete the module must have acquired the following knowledge, skills and competencies:

Knowledge

- Must have knowledge of concepts, theories and methods for analysis, development and implementation of the strategy; including the ability to performance measure this by a combination of both economic and non-economic performance of the organization.

Skills – The student, should with the proper use of management concepts, be able to:

- Apply the learned theories and methods to understand and analyze the company's choice of strategy and performance measurements.
- Assess theoretical and practical problems by developing and implementing changing strategies in established organizations.
- Communicate such issues to other participants of occurring development projects.

Competencies:

- Must be able to apply the learned knowledge elements and skills as a staff employee in strategy development projects.
- Must be able to independently contribute constructively and professionally in strategy investigation and development with other professionals.
- Must on the basis of the acquired identify their own needs for further learning and to implement the appropriate organization hereof.

Teaching methods: Lectures supplemented with workshops, presentation seminars and more.

Exam format: Individual oral or written examination. The exam form is determined at the beginning of the semester.

Evaluation criteria: As stated in the Joint Programme Regulations.

4th semester

Master's Thesis **Kandidatspeciale**

Recommended academic prerequisites:

The module is based upon knowledge obtained in 1st – 3rd semester in the programme

Objective:

The module will give the student the opportunity to demonstrate knowledge, skills and competence at a master level.

The student him/herself formulates the problem addressed, but the problem formulation must be approved by the supervisor and study director before the project begins.

Students who complete the module must have acquired the following knowledge, skills and competencies:

Skills

- Must have knowledge and be able to understand the specialization subjects at the highest international level.
- Must be able to critically assess knowledge and identify emerging scientific issues within the specialization area.
- Must be able to understand the terms of specialization of the research area including research ethics.

Knowledge

- Must be able to independently explain the choice of scientific theoretical and / or experimental methods.
- Must via the project and at the end of it be able to provide an independent and critical assessment of the chosen theories and methods as well as of the analyses, results and conclusions.
- Must be able to use a broad spectrum of engineering methods for research and development in the specialization area.
- Must be able to communicate relevant scientific and engineering professional aspects of the project work in a clear and systematic way to both peers and to the public.

Competencies

- Must independently be able to problem formulate, implement, document, reflect on and communicate results of a project that deals with a complex work and development situation in the central topics of the Master's programme.
- Must be able to evaluate, select and translate academic knowledge, skills and scientific theories, methods and tools on a scientific basis to develop relevant new analytical approaches and justify its choice.
- Must be able to provide solid time and work plans for their own project, independently and critically assess progress, and to select and incorporate relevant literature, experiments or relevant data in order to maintain the scientific basis.
 - Must be able to handle complex and unpredictable work situations and be able to develop new solutions.

- Must independently and with professional and scientific approach engage in dialogue with peers and professional stakeholders in relation to the Master's programme.
- Must be able to communicate the results obtained from the project work in a project report.
- Must be able to work around the project of the problem field and make a joint presentation of the project results.

Teaching methods: Project work with teacher feedback and more.

Exam form: Oral examination based on the presentation seminar and project report.

Evaluation criteria: As stated in the Joint Programme Regulations.

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of 1 February 2018.

Chapter 5: Other Provisions

5.1 Rules concerning written work, including the Master's thesis

In the assessment of all written work, regardless of the language it is written in, weight is also given to the student's spelling and formulation ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are taken as a basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination can be assessed as 'Pass' on the basis of good language performance alone; similarly, an examination normally cannot be assessed as 'Fail' on the basis of poor language performance alone.

The Board of Studies can grant exemption from this in special cases (e.g., dyslexia or a native language other than Danish).

The Master's thesis must include an English summary.¹ If the project is written in English, the summary must be in Danish.² 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.

5.2 Rules concerning credit transfer (merit), including the possibility for choice of modules that are part of another program at a university in Denmark or abroad

The Board of Studies can approve successfully completed (passed) program elements from other Master's programs in lieu of program elements in this program (credit transfer). The Board of Studies can also approve successfully completed (passed) program elements from another Danish program or a program outside of Denmark at the same level in lieu of program elements within this curriculum. Decisions on credit transfer are made by the Board of Studies based on an academic assessment. See the Framework Provisions for the rules on credit transfer.

5.3 Rules for examinations

The rules for examinations are stated in the Examination Policies and Procedures published by The Faculty of Engineering and Science on their website.

5.4 Exemption

In exceptional circumstances, the Board of Studies study can grant exemption from those parts of the curriculum that are not stipulated by law or ministerial order. Exemption regarding an examination applies to the immediate examination.

5.5 Rules and requirements concerning the reading of texts

It is assumed that the student can read academic texts in modern English and use reference works, etc., in other European languages.

5.6 Additional information

The current version of the curriculum is published on the Board of Studies' website, including more detailed information about the programme, including exams.

¹ Or another foreign language (upon approval from the Board of Studies).

² The Board of Studies can grant exemption from this.