Curriculum for the Master of Information and Communication Technologies

Aalborg University
September 2016
Preface

Pursuant to Act 261 of March 18, 2015 on Universities (the University Act) with subsequent changes, the following curriculum for the Master programme in Information and Communication Technologies (MICT) is stipulated. The programme also follows the Joint programme regulations and the Examination Policies and Procedures for the Faculty of Engineering and Science.

Contents

Chapter 1: The curriculum’s legal basis, etc. .......................................................................................... 3
  1.1 Basis in ministerial orders ........................................................................................................... 3
  1.2 Faculty affiliation ....................................................................................................................... 3
  1.3 Board of Studies affiliation ...................................................................................................... 3

Chapter 2: Admission, title, duration and competence profile ............................................................ 3
  2.1 Admission ................................................................................................................................ 3
  2.2 The programme title in Danish and English .......................................................................... 3
  2.3 The prescribed number of ECTS ............................................................................................ 3
  2.4 The diploma competence profile .............................................................................................. 4
  2.5 A description of the professional profile and competence profile of the programme .......... 4

Chapter 3: Content and organization of the programme ...................................................................... 6
  3.1 1st trimester ................................................................................................................................ 9
    3.1.1 Project Unit at 1st trimester ................................................................................................. 9
    3.1.2 Courses at 1st trimester .................................................................................................. 13
  3.2 2nd trimester ........................................................................................................................... 16
    3.2.1 Project Unit at 2nd trimester ............................................................................................ 17
    3.2.2 Courses at 2nd trimester ................................................................................................ 20
  3.3 3rd trimester ........................................................................................................................... 24
    3.3.1 Project Unit at 3rd trimester ............................................................................................. 24
    3.3.2 Courses at 3rd trimester ................................................................................................ 25

Chapter 4: Effective date, interim regulations and revision ............................................................... 27

Chapter 5: Other regulations ........................................................................................................... 27
  5.1 Rules for written assignments, including the master’s thesis project and its scope .......... 27
  5.2 Rules concerning credit transfer (merit), including the possibility for choice of modules that are part of another programme at a university in Denmark or abroad ........................................ 27
  5.3 Examination rules .................................................................................................................. 27
  5.4 Exemption .............................................................................................................................. 27
  5.5 Rules for when the students should at the latest have completed their education after its commencement .................................................................................................................. 27
  5.6 Additional information .......................................................................................................... 27
Chapter 1: The curriculum’s legal basis, etc.

1.1 Basis in ministerial orders
The Master programme in Information and Communication Technologies (MICT) is organised in accordance with the Ministry of Science, Innovation and Higher Education’s Order no. 1188 from December 7 2009 (deltidsbekendtgørelsen), the order no. 1187 from December 7 2009 regarding master programmes the order no. 670 from June 19 2014 regarding exams and grading of university educations (Eksamensbekendtgørelsen) including the later changes. Furthermore, reference is made to the order no. 114 from February 3 2015 (Karakterbekendtgørelsen) including later changes.

As indicated in the order the education is a one-year’s master programme at Master of Science level, which is provided under the Open Education. The education is offered as a) one year full time study, b) two years part time study and c) three years part time study.

1.2 Faculty affiliation
The Master programme falls under the Faculty of Engineering and Science, Aalborg University (AAU).

1.3 Board of Studies affiliation
The Master programme falls under the Board of Studies for Electronics and Information Technology.

Chapter 2: Admission, title, duration and competence profile

2.1 Admission
Admission to the master programme in ICT (MICT) presupposes a relevant higher education at least at bachelor level and at least 2 years of relevant professional experience pursuant to the completion of a qualifying exam.

Relevant bachelor educations are:
- Bachelor of science (BSc) or Bachelor of Engineering (“diplomingeniør”) degree within the fields of IT, Communication or electronics,
- Bachelor degree within the area of Computer Science or Software Technologies,

or other relevant education within technical IT.

Aalborg University can provide access to the study for candidates who do not meet the academic conditions of access, but who are considered to have the necessary prerequisites to accomplish this. The requirement of relevant professional experience cannot be exempted.

2.2 The programme title in Danish and English
The master programme entitles students to the title:
- Master i informations- og kommunikationsteknologier / Master of Information and Communication Technologies.

2.3 The prescribed number of ECTS
The education is the equivalent of a one-year full-time study (60 ECTS) offered as: a) one year of full-time study, b) two years of part-time study or c) three years of part-time study. Individual modules of the programme can also be followed to the extent that the necessary prerequisites are met.
The study form consists of courses as well as project work, individually and in groups.

2.4 The diploma competence profile
The following competence profile will be given in the diploma:

A graduate of the Master programme has competencies acquired through the course of an educational programme based in the integration of research results and practical experiences.

The graduate of the Master programme can through scientifically grounded personal and professional competencies perform highly qualified functions in the labor market.

2.5 A description of the professional profile and competence profile of the programme:

The person obtaining a degree at this level:

Knowledge

- has knowledge on information and communication technologies (ICT) that is based on the highest level of international research
- has in-depth knowledge and understanding of issues within the areas: service development, ICT infrastructures, markets and business models
- can understand and, on a scientific basis, reflect on the technical, organizational and market drivers in the convergence of ICT as well as the interplay between technology, market and user issues
- can reflect on the knowledge, theory, methodologies and practice within the field of ICT, and identify scientific issues
- understands the importance of innovation, creativity and entrepreneurship for ICT solutions and services
- understands the relevance of the needs of the end users, their use of ICT, and the mechanisms that influence the user experience and the acceptance of new technologies
- has a holistic understanding of the environment of ICT services and solutions: Scenarios of use, target users, stakeholders, business aspects, etc.
- Depending on the track:
  - mICT-MII\(^1\): has understanding of the work processes and process optimisations in the companies
  - mICT-MII: has understanding of cognitive psychology theories that are relevant for product and service design
  - mICT-ISP\(^2\): has knowledge about future Internet both from a network and a service architecture perspective
  - mICT-ISP: has knowledge about development tools for ICT and media services
  - mICT-CIS\(^3\): has an overall knowledge about the latest cyber security and cybercrime law including regulation on personal data and privacy
  - MICT-CIS: has knowledge about latest cyber threats and possible tools to mitigate those threats.

Skills

- excels in scientific methods, tools and general skills within the field of communication technologies and markets,
- can evaluate and select among relevant scientific theories, methods, tools and general skills and, on a scientific basis, advance new analyses and solutions within the subject areas

\(^1\) mICT-MII: Management of ICT Innovations  
\(^2\) mICT-ISP: ICT Services and Platforms  
\(^3\) mICT-CIS: ICT Cyber and Information Security
• can communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists
• excels in scientific writing: Articles, reports, documentation, etc.
• can identify and select among relevant standards, technologies and methods for development of ICT solutions and services
• can assess and compare different technologies for optimal technology selection, strategic decisions and business development
• can assess the market, ethical and regulatory framework for application of the technologies.
• can develop innovative services, applications and solutions at a conceptual level, which are relevant in a user perspective.
• can assess the implications and business potential of new ICT solutions and services and develop viable business models
• depending on the track:
  o mICT-MII: are able to optimise the service and product development processes within the companies
  o mICT-ISP: can develop prototypes or demonstrators of viable ICT solutions and services, based on in-depth analysis of user requirements, technology and market issues and using state-of-the-art methods, technologies and tools
  o MICT-CIS: are able to assist technical designers in design and development of secure software solutions for enterprises keeping cyber security challenges and legal perspectives in mind.

Competencies
• 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 specialization
• has competencies in project work and problem based learning in a global/multicultural environment
• has competencies in business development in a holistic perspective, based on a thorough understanding of the interplay between technology, market and users in ICT and media
• can contribute creatively and innovatively to identify and propose new business opportunities and develop services/solutions, which can empower the users and assist them in solving their current and future tasks on a daily basis
• can mediate collaboration and exchange between development- and business-related functions in organizations.
Chapter 3: Content and organization of the programme

The programme is structured in modules and organized 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. Examinations are defined in the curriculum.

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

- lectures
- classroom instruction
- project work
- workshops
- exercises (individually and in groups)
- teacher feedback
- reflection
- portfolio work

Furthermore, in this programme advanced teaching and learning tools, including E-learning and video conferencing tools will be used intensively.

Overview of the programme
Within the mlCT programme three tracks are offered:

- ICT Services and Platforms (mlCT-ISP)
- Management of ICT Innovations (mlCT-MII)
- ICT Cyber and Information Security (mlCT-CIS)

All tracks have the interdisciplinary approach combining the above mentioned academic areas. The mlCT-ISP track has a more technical focus and provides theories, tools and methods for development of ICT and media services while the mlCT-MII track has a more managerial focus and includes the theories, methods and tools for understanding the business processes and service design. And mlCT-CIS track focuses on cyber security and crime from a technological and law perspective.

An overview of the curriculum is depicted in Table 1.

Throughout the education 3 main academic areas are covered:

- Networks and services
- Design and users
- Market and business

These are depicted in the main rows of Table 1.

The education is provided in 3 trimesters, where a trimester in the full time (one year) version of the education is equivalent to 4 months, in the part time (two years) version is equivalent to 8 months and in the part time (three years) version is equivalent to one year.

Each trimester has a topic, which is depicted in the main columns of Table 1.

The project work in the 3rd trimester of the education constitutes the final project work and has a workload of 15 ECTS points. The final thesis project will be carried out either individually or in
groups. If the final project is done in groups the preferable size for a group is 2 and the maximum size is 3. Each student will be given an individual mark according to the 7-point scale.

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

Individual examinations will take place in all courses. The examinations will be either oral or written exams. The evaluation form is indicated in the course descriptions.

The 60 ECTS include:
• 25 ECTS courses
• 35 ECTS projects

25 ECTS will be evaluated with external examiner. This includes the project in the first trimester and the final thesis project.

In Table 1 it is indicated which courses belong to mICT-ISP, mICT-MII and mICT-CIS specializations. Also courses common for all specializations are indicated in the table. Furthermore in the 3rd trimester two elective courses are offered.

<table>
<thead>
<tr>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd trimester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEME:</strong> ISP: Services and platforms</td>
<td><strong>THEME:</strong> ISP: Application development</td>
<td><strong>THEME:</strong> Master Project</td>
</tr>
<tr>
<td>MII: Organizations and Innovations</td>
<td>MII: Design and Innovation</td>
<td></td>
</tr>
<tr>
<td>CIS: Enterprises Cyber Security</td>
<td>CIS: Privacy &amp; Security frameworks in Organizations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>ECTS</th>
<th>Track</th>
<th>Course Title</th>
<th>ECTS</th>
<th>Track</th>
<th>Course Title</th>
<th>ECTS</th>
<th>Track</th>
</tr>
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<tbody>
<tr>
<td>Networks and services</td>
<td>Communication technologies and service architectures</td>
<td>5</td>
<td>ISP</td>
<td>Development of ICT and media services</td>
<td>5</td>
<td>ISP</td>
<td>Identity and access management</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Cyber security and trust</td>
<td>5</td>
<td>CIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design &amp; Users</td>
<td>Interaction design Cognitive Psychology</td>
<td>5</td>
<td>All*</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
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<td></td>
</tr>
<tr>
<td>Market and business</td>
<td>Entrepreneurship, Innovation and Business Models</td>
<td>5</td>
<td>All*</td>
<td>Markets, regulation and standardization</td>
<td>5</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology Management and Business Processes</td>
<td>5</td>
<td>MII</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Cybercrime and Information Security Law</td>
<td>5</td>
<td>CIS</td>
<td></td>
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<tr>
<td>Project (ECTS)</td>
<td>10</td>
<td></td>
<td>10</td>
<td></td>
<td>15</td>
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</tr>
</tbody>
</table>

* These courses are common for all tracks
** Only one of the elective courses can be selected for the third trimester

Table 1: Overview of the MICT curriculum.
More details about the modules are depicted in Table 2.

<table>
<thead>
<tr>
<th>Trimester</th>
<th>Module</th>
<th>mICT-ISP</th>
<th>mICT-MII</th>
<th>mICT-CIS</th>
<th>ECTS</th>
<th>Assessment</th>
<th>Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Entrepreneurship, Innovation and Business Models</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Cybercrime and Information Security Law</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>5</td>
<td>7-Point scale Internal</td>
</tr>
<tr>
<td></td>
<td>Technology Management and Business Processes</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>5</td>
<td>7-Point scale Internal</td>
</tr>
<tr>
<td></td>
<td>Communication Technologies and Service Architectures</td>
<td>X</td>
<td></td>
<td></td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Enterprises Cyber Security*</td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
<td>7-Point scale</td>
<td>External</td>
</tr>
<tr>
<td></td>
<td>Organizations and Innovations*</td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
<td>7-Point scale</td>
<td>External</td>
</tr>
<tr>
<td></td>
<td>Services and Platforms*</td>
<td>X</td>
<td></td>
<td></td>
<td>10</td>
<td>7-Point scale</td>
<td>External</td>
</tr>
<tr>
<td>2nd</td>
<td>Interaction Design</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Cyber Security and Trust</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>5</td>
<td>7-Point scale Internal</td>
</tr>
<tr>
<td></td>
<td>Cognitive Psychology</td>
<td>X</td>
<td></td>
<td></td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Development of ICT and Media Services</td>
<td>X</td>
<td></td>
<td></td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Privacy &amp; Security frameworks in Organizations</td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Design and Innovation</td>
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<td></td>
<td></td>
<td>10</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Application Development</td>
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<td>10</td>
<td>7-Point scale</td>
<td>Internal</td>
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<td>Markets, Regulation and Standardization</td>
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<td>Elective</td>
<td>Elective</td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Identity and Access Management</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>5</td>
<td>7-Point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Master’s Thesis</td>
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<td>X</td>
<td>X</td>
<td>15</td>
<td>7-Point scale</td>
<td>External</td>
</tr>
</tbody>
</table>

*The sub-module “POPBL and scientific methods” is part of the semester project on the 1st trimester. The students must complete and pass a partial exam in this sub-module before taking the final exam in the trimester project.

**Only one of the elective courses can be selected for the third trimester**

**Table 2: Overview of the course modules.**
## 3.1 1st trimester

### 3.1.1 Project Unit at 1st trimester

<table>
<thead>
<tr>
<th>Trimester project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ISP track</td>
</tr>
<tr>
<td>Services and Platforms (Services og platforme)</td>
</tr>
</tbody>
</table>

**Prerequisites:** The sub-module: ‘POPBL and scientific methods’ is a part of this project and the students must pass this sub-module before they go to the project exam.

**Objectives:**
Students who complete the module:

**Knowledge**
- Must have knowledge about the key technologies and standards for networks and systems
- Must have knowledge about the characteristics of different networks and the technologies that are important to provide a good user experience for a service
- Must be able to understand the service architectures, platforms and business models that are needed to provide future services and applications

**Skills**
- Must be able to discuss the technical and business-related aspects of service architectures
- Must be able to carry out a detailed analysis of a service, an application or a technical design and develop a well-founded requirement specification for the service
- Must be able to conceptually construct relevant business models
- Must be able to assess networks characteristics and limitations
- Must be able to identify relevant service enablers and the specific requirements imposed by the service(s)

**Competencies**
- Must have competencies within at least one of the following areas:
  - be able to transform an identified user need into a conceptual design of a realistic ICT service
  - be able to analyse the viability and potential of different technologies, applications and services in order to make well-founded choices of technologies and strategies
- Must be able to take advantage of combining networks and technologies in innovative ways for development of services and solutions

**Type of instruction:** Project work.

**Exam format:** Oral examination based on a written report.

**Evaluation criteria:** Are stated in the Joint programme regulations.
**Trimester project:**
- **MII track**

**Organizations and Innovations**  
*(Organisationer og innovationer)*

**Prerequisites:** The sub-module: ‘POPBL and scientific methods’ is a part of this project and the students must pass this sub-module before they go to the project exam.

**Objectives:**

Students who complete the module:

**Knowledge**
- Must have knowledge about business processes and process optimisation
- Must have knowledge about innovation processes
- Must have knowledge about models for diffusion and adoption of technology
- Must have knowledge about technology management

**Skills**
- Must be able to discuss the technical and business-related aspects of service architectures
- Must be able to carry out a detailed analysis of a service, an application or a technical design and develop a well-founded requirement specification for the service
- Must be able to conceptually construct relevant business models
- Must be able to draft a business plan
- Must be able to carry out change management in relation to ICT services

**Competencies**
- Must have competencies in analysing the business model for a company within the context of a value chain analysis.
- Must have competencies in preparing an innovation strategy and a business plan for a company.

**Type of instruction:** Project work.

**Exam format:** Oral examination based on a written report.

**Evaluation criteria:** Are stated in the Joint programme regulations.
**Trimester project:**
- **CIS track**

**Enterprises Cyber Security**
(Cyber-security I virksomheder)

**Prerequisites:** The sub-module: ‘POPBL and scientific methods are a part of this project and the students must pass this sub-module before they go to the project exam.

**Objectives:**
Students who complete the module:

**Knowledge**
- Must have an overall knowledge about legal problems and legal measures to prevent or diminish problems within the following areas:
  - Personal data and other related information on privacy.
  - Intellectual Property Rights (IPR).
  - Protecting business secrets
  - Net and information security,
  - Criminal cyberattacks

- Must have an overall understanding of what protection and rights the law from the areas listed above offers companies and individuals in specific situations.
- Must have an overall knowledge about what obligations individuals and companies are subject to within the law in relation to different cyber security, privacy and cybercrime problems within an enterprise.

**Skills**
- Must be able to analyze a future comprehensive security service or cyber security solution *within the relevant legal framework* that is solidly technical founded preventing cyberattacks to ensure privacy as well as protection of personal data and other business secrets
- Must be able to undertake an analysis of specific law for applications of technology choices, strategic decisions and innovation
- Must be able to make an overall legal analysis of given cybercrime, cyber security or privacy problem within an enterprise to contribute to select the needed and useful measures to protect the company from further problems in this areas.

**Competencies**
- Must have competence to deal with cyberattacks from a legal perspective in an appropriate and timely manner.
- Must have competence to assist legal professionals to establish the necessary compliance procedures within the relevant regulatory frameworks to protect enterprises from breaching the regulation on personal data and privacy, but at the same time have a plan for protecting business secrets and IPRs from cyberattacks.

**Type of instruction:** The project is performed individually or in small groups of a maximum of three members. At least one internal supervisor is assigned, who works with the primary subject within his/her research. Moreover, additional supervisors e.g. from industry can be involved in the project.

**Exam format:** Oral examination based on a written report.

**Evaluation criteria:** Are stated in the Joint programme regulations.
Sub-module of the trimester project:
- ISP, MII and CIS track
POPBL and Scientific Methods
(POPBL og videnskabelige metoder)

Objectives:
This sub-module is a part of 1st trimester project and in workload counts for 2 ECTS.

Students who complete the sub-module:

Knowledge
- Must have knowledge about Problem Based Learning
- Must have knowledge about conflict handling
- Must be able to understand the challenges of inter-cultural group work
- Must be able to plan group work using project planning tools (such as Gantt chart)
- Must have knowledge about the concept of process analysis
- Must have knowledge about different learning styles
- Must have knowledge about scientific methods and the applicability in engineering educations
- Must have knowledge about science theory in relation to hypothesis, theories, inductivism vs. deductivism, amongst others
- Must understand the difference between qualitative and quantitative methods
- Must understand the principles for citing other people’s work properly and understand the consequences of plagiarism

Skills
- Must be able to apply the principles of Problem Based Learning in practice
- Must be able to apply a Gantt chart to the first semester project
- Must be able to prepare a process analysis and use it for evaluation of the group work
- Must be able to discuss the concept of scientific methods
- Must be able to cite other people’s work properly
- Must be able to structure a project report
- Must be able to apply different scientific methods for a particular problem

Competencies
- Must have competencies in group work and project-organized learning
- Must have competencies in communication in a group
- Must have competencies in use of scientific methods
- Must have competencies in setting up a report as a scientific document

Type of instruction:
Lectures, exercises (individually and in groups), reflection, feedback, self-study.

Assessment: Individual oral or written examination.

Assessment criteria: Are mentioned in the Joint programme regulations
3.1.2 Courses at 1st trimester

Course module:
- ISP, MII and CIS track
  Entrepreneurship, Innovation and Business Models
  (Entreprenørskab, Innovation og Forretningsmodeller)

Objectives:
Students who complete the module:

Knowledge
- Must have knowledge on theories regarding business development based on information and communication technologies, including network economics, information economics, transaction costs analysis, behavioural economics, and business ecosystems
- Must have knowledge on theories on diffusion and adoption
- Must be able to understand theories on innovation and entrepreneurship
- Must have knowledge on managerial economics including business plans and pricing strategies

Skills
- Must be able to apply theories and methodological tools on specific company and technology cases
- Must be able to evaluate the application of business models in different business areas
- Must be able to utilize approaches from managerial economics on entrepreneurial projects
- Must be able to apply theories and methodologies to the analysis of diffusion and adoption of technology solutions

Competencies
- Must have the competencies to discuss the links between different design elements of business models: customer value, organization, technology and financial issues
- Must have acquired the knowledge and skills to explain the key linkages between the different theories of the course, and use these critically in an analysis of market trends and business models
- Must have acquired the ability to combine knowledge on technological solutions with business development and business potential
- Must master theories and methodological tools to analyse and suggest appropriate and innovative business models for companies offering ICT services and products and using ICT solutions in their business operations

Type of instruction: Types of instruction are listed in Chapter 3.

Exam format: Individual oral or written examination.

Evaluation criteria: Are stated in the Joint programme regulations.
Course module:
- MII track
Technology Management and Business Processes
(Teknologiledelse og forretningsprocesser)

Objectives:
Students who complete the module:

Knowledge
• Have gained knowledge about theories, methods and tools for operation management
• Have gained knowledge about theories, methods and tools for supply chain management
• Have gained knowledge about process optimization, including specific methods and tools like: Technology radar, eTOM, ITIL, LEAN, Six sigma and ARIS
• Have gained knowledge and understanding of the role of technology, innovation, and change in businesses
• Have gained knowledge about organizational change strategies and process models
• Have gained insight into organizing for change (including aspects for culture, power and politics)
• Have gained knowledge about enablers and disablers of change.

Skills
• Be able to identify specific problems/issues and future challenges in their own firms and apply these theories and methods on them
• Be able to develop and implement an appropriate project design that identifies the processes of product development, operations and supply chain and their interactions.
• Be able to understand the range, scope and complexity of challenges related to the management of technology, innovation and change
• Be able to describe, analyze and redesign innovation- and change management processes
• Be able to identify and analyze the field of innovation and change management including the value position of stakeholders; customers, suppliers and other network partners
• Be able to design, evaluate and audit the innovative capabilities and change management of a business organization
• Be able to apply principles of business model innovation and risk management to suggest redesign and improvement of business models.

Competencies
• Be able to present, validate, argue and evaluate the analytical results found
• Be able to design and evaluate innovation- and change management
• Be able to realize and implement innovation- and change management initiatives, including the implementation and design innovation- and change management processes in projects, companies and networks of companies, as well as relating practical innovation- and change management experiences to concept

Type of instruction: Types of instruction are listed in Chapter 3.

Exam format: Individual oral or written examination.

Evaluation criteria: Are stated in the Joint programme regulations.
### Course module:
- ** ISP track  

**Communication Technologies and Service Architectures**  
(Kommunikationsteknologier og tjenestearkitekturer)

### Objectives:
Students who complete the module:

**Knowledge**  
Must have knowledge about:
- Spectrum limitations and spectral efficiency.  
- Fixed and mobile/wireless broadband infrastructures.  
- Short-range technologies.  
- Digital broadcast networks (radio and TV).  
- New network architectures, including, CDN, SDN, ICN.  
- The structure of the Internet and its design principles.  
- The key Internet technologies for content networking: representation, identification and transport  
- Programming models and interfaces for Internet services, in particular REST, SOAP and Web Services  
- The main protocols for streaming media, including session initiation and management  
- Mark-up languages and AJAX technologies, e.g. XML, JSON, HTML5, and JavaScript

**Skills**  
Must be able to:
- Explain the technical parameters, which drive the development of future networks.  
- Evaluate to what extent the future mobile and fixed networks complement or substitute each other.  
- Evaluate the strengths and weaknesses in the use of traditional mobile networks, wireless or broadcast networks for mobile TV/radio transmission.  
- Evaluate QoS requirements for Internet applications and services.  
- Understand the potentials of converged infrastructures.  
- Explain the concepts of “service”, “service enablers” and “service architectures”  
- Reflect on methods for “enrichment” of services: personalization, use of context, etc.  
- Design services for real-time content distribution, including streaming media

**Competencies**  
Must have the competency to:
- Identify and discuss the key technologies and standards for broadband networks and the properties of networks that are essential for supporting services.  
- Analyse and assess the potential and limitations of existing and future communication and service infrastructures and help develop new solutions.  
- Make a qualified choice of technologies, methods, platforms and service architecture in order to realize a given service.

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<tr>
<th><strong>Type of instruction:</strong></th>
<th>Types of instruction are listed in Chapter 3.</th>
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<td><strong>Exam format:</strong></td>
<td>Individual oral or written examination.</td>
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<td><strong>Evaluation criteria:</strong></td>
<td>Are stated in the Joint programme regulations.</td>
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</tbody>
</table>
Course module:
- CIS track

**Cybercrime and Information Security Law**
(Cyberkriminalitet og Informationssikkerhed)

### Objectives:
Students who complete the module:

**Knowledge**
- Must have knowledge about the regulation on personal data and other related privacy rules.
- Must have knowledge about basic regulation on Intellectual Property Rights (IPR).
- Must have knowledge about EU law protecting business secrets that are protected and worth protecting from hacker-attacks from a civil and criminal perspective.
- Must have knowledge about regulation covering net security (ensuring the protection of personal data, business and governments secrets).
- Must have knowledge about regulation on information security, including the safeguarding of information through risk management.
- Must have knowledge about reporting obligations and security plans.
- Must have knowledge about security regulations within the Personal Data Act and special regulations covering information security.
- Must have knowledge about EU regulation on risk management and information security as well as the EU policy in this area.
- Must have knowledge about securing evidence after a cyber-attack for use in further investigations or court proceedings.

**Skills**
- Must be able to identify which criminal acts that may be violated in different cyberattacks or hacker-attacks and the criminal procedures that cover this.
- Must be able to identify requirements and create policies to establish a consistent IT architecture that assure information protection.
- Must be able to identify security incidents or cybercrimes and act in timely manner to ensure relevant evidences.

**Competencies**
- Must have the competency to select and prioritize measures for protection of networks, services, personal data and other protectable information, and thus prepare an information security policy and security plans.
- Must be able regularly as part of a company's planning and operation to take appropriate technical and organizational measures to manage the risks to ensure personal security of networks and services that meet a certain level of security.
- Must have the competency to act in timely manner on criminal acts and seek to establish the necessary procedures to ensure evidence to be able to analyze and respond to a possible virus or hacker attack.

### Type of instruction:
Types of instruction are listed at the start of Chapter 3.

### Exam format:
Individual oral or written examination.

### Evaluation criteria:
Are stated in the Joint programme regulations.
3.2 2nd trimester

3.2.1 Project Unit at 2nd trimester

<table>
<thead>
<tr>
<th>Trimester project:</th>
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<tr>
<td>ISP track</td>
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<tr>
<td>Application Development (Applikationsudvikling)</td>
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Objectives:
Students who complete the module:

Knowledge
- Must have knowledge about appropriate methods for design, test and analysis of applications or services based on current or future ICT platforms
- Must have knowledge about the necessary tools to develop ICT or media applications / services
- Must have knowledge of the implications that mobile platforms, devices, applications and services provide to Interaction Design and to the user interface of the application/services

Skills
- Must be able to analyse and assess user needs and ICT impact in relation to the design of new applications, software, mobile devices, etc.
- Must be able to reflect on the application development process and to characterize the process in relation to existing life cycle models
- Must be able to analyse, design, develop and test applications and services that can be deployed on ICT and media platforms and infrastructures
- Must be able to carry out the technical development process with a constant focus on target users, usage scenarios, stakeholders and business aspects to ensure the validity of approaches
- Must be able to identify and apply relevant theories and methods for synthesis and evaluation of the user interaction
- Must be capable of exploring and applying the potential of ICT to address a wide variety of private and professional user needs

Competencies
- Must have the competency to analyse a technical service design and develop one or more of the applications necessary to provide the service based on a specific user need.
- Must have the competency to follow a design process with use of scenarios, use cases, requirement specification and the final prototype design.
- Must be able to assess and develop (conceptually and paper based) a Graphical User Interface (GUI) for a specific application or a service prototype

Type of instruction: Project work, self-study and reflection

Exam format: Oral examination based on a written report.

Evaluation criteria: Are stated in the Joint programme regulations.
**Trimester project:**
- **MII track**

Design and Innovation  
(*Design og innovation*)

**Objectives:**

Students who complete the module:

**Knowledge**
- Must have knowledge about (and be able to use) different techniques and methods for elicitation of user requirements hereunder creativity techniques.
- Must have knowledge in cognitive psychology
- Must have knowledge about different types of services and the psychological perspectives of user acceptance of these
- Must have knowledge about different user segmentation models

**Skills**
- Must be able to include users' requirements and needs in the design of new services, which can also be based on the re-thinking of an existing product/service design.
- Must be able to identify and apply relevant theories and methods for synthesis and evaluation of the user interaction
- Must be capable to identify and apply relevant theories for synthesis and evaluation of user interaction for service development
- Must be able to link aspects of cognitive psychology to development of new services

**Competencies**
- Must have the competency to analyse a technical service and develop a conceptual design of one or more of the applications necessary to provide the service based on a specific user need.
- Must be able to within one of the company's core areas to give an analysis of the need for the development of draft proposals for a new innovative solution concept.
- Must be able to construct a conceptual prototype followed by the test of the concept.
- Must be able to analyse and respond to cognitive elements of design of services
- Must be able to use different segmentation models for targeting a (conceptual) design process
- Must be able to assess and develop a conceptually based (for example on paper) user interface for a specific service prototype

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<tr>
<th><strong>Type of instruction:</strong></th>
<th>Project work, self-study and reflection</th>
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<tr>
<td><strong>Exam format:</strong></td>
<td>Oral examination based on a written report.</td>
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<tr>
<td><strong>Evaluation criteria:</strong></td>
<td>Are stated in the Joint programme regulations.</td>
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</tbody>
</table>
Semester project:
  - CIS track

Privacy & Security frameworks in Organizations
(Privacy og sikkerhedsrammer i organisationer)

Objectives:
Students who complete the module:

Knowledge
  - Must have knowledge of top cyber security threats like, destructive malware, fake antiviruses & Denial-of-Service attacks in organizations
  - Must have knowledge of appropriate security methods for analysis, design and test of applications and services in enterprises.
  - Must have knowledge about how to design and define security policies for trusted and untrusted devices Ex., Bring your own device (BYOD).

Skills
  - Must be able to apply the knowledge of interaction design in cyber security and trust to design Cyber Trust Indicators i.e., Usable Security
  - Must be able to incorporate principles of usability into the design of secure systems
  - Must be able to efficiently design and implement commonly used cryptosystems i.e., Cryptography
  - Must be able to design and develop techniques for avoiding, finding, and fixing software vulnerabilities.
  - Must be able to design and develop security services and solutions targeting a specific application domain i.e., Software Security
  - Must be able to identify, select and apply state-of-the-art technologies for fine-grained control of information in enterprises.

Competencies
  - Must have the competency to build secure system incorporating techniques from
    - Human Interaction and Usable Security
    - Commonly Used Cryptosystems
    - Secure software Implementation
    - Hardware Security
  - Must have the competency to discuss, analyse and develop conceptual privacy and security policies and architectures
  - Must have the competency to argue for solutions and suggestions based on theories, state-of-the-art studies within privacy and security and interaction design

Type of instruction: Project work

Exam format: Oral examination based on a written report

Evaluation criteria: Are stated in the Joint programme regulations.
3.2.2 Courses at 2nd trimester

Course module:
- ISP, MII and CIS track

Interaction Design
(Interaktionsdesign)

Objectives:
- To provide students with Competencies to develop requirements (hereunder user requirements) for new service design. It is here emphasised that the development of services can take place on a conceptual level.
- To understand how creativity can be built into a requirement engineering process.
- To support the students in gaining insight into user centric design and to understand how this can be the basis for requirements for new services in general.

Students who complete the module:

Knowledge
- Be able to understand central concepts of interaction design such as: user centric development, process models, GUI (graphical User Interfaces), usability, user experience, amongst others.
- Know different techniques and methods for elicitation of user requirements hereunder creativity techniques.
- understand the concept of Lead Users as well as other types of user segmentations
- Be able to transform user requirements into interaction design.
- Know different techniques and methods for evaluation of various ICT services.
- Be able to use theories and methods applied in professional interaction design for construction of conceptual, innovative services.

Skills
- Be able to apply the concept of user experience to service design.
- Be able to evaluate a IT service using techniques from interaction design and Human Computer Interaction.
- Be able to elicitate user requirements for new services by involvement of users and application of techniques (such as “think-aloud” test, and interviews). Be able to reflect on user involvement.

Competencies
- Have competencies in conceptual evaluation of ICT services.
- Have competencies in development of a software specification for a particular IT service.
- Be able to analyse the social context in which the use of ICT takes place.
- Have competencies in involvement of users in an conceptual ICT service development process.
- Have competencies in techniques for elicitation of user requirements.

Type of instruction: Types of instruction are listed in Chapter 3.

Form of examination: Individual oral or written examination.

Assessment criteria: Are mentioned in the Joint programme regulations.
**Course module:**
- ISP track

**Development of ICT and Media Services**
(Udvikling af IKT- og medietjenester)

**Objectives:**
Students who complete the module:

**Knowledge**
- Must be able to understand architectural issues such as the division of functions between terminal, server and networks.
- Must have knowledge about Internet of Things.
- Must have knowledge about smart sensors and smart actuators.
- Must understand general sensor architecture, structure and communication.
- Must have knowledge about basic artificial intelligence and pattern recognition algorithms and principles.
- Must have knowledge about platform programming and scripting (Tablets, Raspberry-pi, Arduino, Smart TV, etc.).
- Must understand interface and communication concepts in relation to external servers, databases, and cloud-based services.
- Must have knowledge about a range of software technologies (e.g. Python, Java, mySQL).
- Must have knowledge about different Software Development Toolkits (SDK), simulators, emulators and Integrated Development Environment (IDE).

**Skills**
- Must be able to design and implement platform services/applications using high-level programming languages and development platforms.
- Must be able to perform platform programming and scripting (Raspberry Pi, Arduino, IoS, Smart TV, etc.).
- Must be able to use sensors and actuators to implement Internet of Thing related systems and devices.
- Must be able to use simple artificial intelligence algorithms in platform services and applications.
- Must be able to interface, communicate and use external servers, databases, and cloud-based services.
- Must be able to design, develop and evaluate platform software components.
- Must be able to produce technical documentation.

**Competencies**
- Must have the competency to design and develop viable ICT and media services that can address a wide range of user needs and provide with a good user experience
- Must have the competency to compose more advanced service functionality using state-of-the-art software tools, Internet of Things, cloud architectures, sensors and simple artificial intelligence algorithms.

**Type of instruction:**
Types of instruction are listed in Chapter 3.

**Exam format:**
Individual oral or written examination.

**Evaluation criteria:**
Are stated in the Joint programme regulations.
## Course module:
- MII track

**Cognitive Psychology**  
(*Kognitiv psykologi*)

## Objectives:
Students who complete the module:

### Knowledge
- Have gained knowledge about theoretical and historical perspectives within cognitive psychology
- Have gained knowledge about theories and methods in cognitive psychology and neuroscience (e.g. experimental psychology, and specific advanced methods like EEG, MRI, fMRI, and PET)
- Have gained knowledge about the central topics within cognitive psychology (e.g. memory, attention, learning, and problem-solving)
- Have gained knowledge about current research topics in both cognitive psychology and cognitive neuroscience

### Skills
- Be able to evaluate and choose between relevant theories in central topics of cognitive psychology
- Be able to explain the strengths and weaknesses of central topics in cognitive psychology
- Be able to evaluate empirical evidence in relation to cognitive psychology
- Be able to disseminate research-based knowledge in cognitive psychology
- Be able to relate the acquired knowledge to skills related to practical solutions within the field of cognitive psychology

### Competencies
- Be able to relate theories on cognitive psychology in an applied setting
- Be able to apply both theory and empiric results in critical discussion within cognitive psychology (e.g. memory and attention).

## Type of instruction:
Types of instruction are listed in Chapter 3.

## Form of examination:
Individual oral or written examination.

## Assessment criteria:
Are mentioned in the Joint programme regulations.
Course module:
- CIS track

**Cyber Security and Trust**
(\textit{Cyber-sikkerhed og tillid})

Prerequisites: The module builds on basic understanding of network security.

**Objectives:** Students who complete the module:

**Knowledge**
- Must have knowledge of standards addressing top cyber security challenges
- Must have knowledge of effective measures that cyber security programs should take
- Must have knowledge of trusted and open architectures
- Must have an understanding of device security trends and threats associated with “Bring your own device” (BYOD)
- Must have knowledge of (mobile) device management and integrity factors for trusted and untrusted devices
- Must have knowledge of strong user and machine authentication based on valuable assets
- Must have knowledge of hardware-based encryption (“Security on chip”) for higher performance
- Must have a knowledge of technologies already embedded in enterprise endpoints
- Must have knowledge of cyber attacks
- Must have knowledge of behavioural profiling and intrusion prevention tools for layer defences
- Must have knowledge of security services and policies within public and private cloud networks

**Skills**
- Must be able to identify requirements and create policies to establish a consistent architecture
- Must be able to monitor, detect and respond to anomalies in the cyber-space
- Must be able to analyse the integrity of the platform to ensure that no unauthorized use has occurred.
- Must be able to design and implement different levels of trust in open architectures.

**Competencies**
- Must have the competency to design cyber security measures for enterprises
- Must have the competency to discuss end-to-end standards to enable seamless security in an open ecosystem.
- Must have the competency to discuss the business potential and implications of trusted ecosystems

**Type of instruction:** Types of instruction are listed at the start of Chapter 3.

**Exam format:** Individual oral or written examination.

**Evaluation criteria:** Are stated in the Joint programme regulations.
### 3.3 3\textsuperscript{rd} trimester

#### 3.3.1 Project Unit at 3\textsuperscript{rd} trimester

<table>
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<th>Trimester project:</th>
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<tbody>
<tr>
<td>- ISP, MII and CIS track</td>
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| Master’s Thesis (Kandidatsepciale) |

| Prerequisites: | 1\textsuperscript{st} and 2\textsuperscript{nd} trimester courses and projects must be completed. |

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<th>Objectives:</th>
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<td>Students who complete the module:</td>
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**Knowledge**
- Must be able to understand the relevance of the chosen problem in relation to services, infrastructure, entrepreneurship and innovation including specific knowledge on the core of the problem and the technical context
- Must be able to understand at synthesis level relevant theories and methods in a way that underlines important properties, and thus documents the knowledge about the applied theories, methods and delimitations within the problem field

**Skills**
- Must be able to design, develop or analyse a comprehensive service or solution that is solidly technical founded, meets end-user requirements and is validated from a market and business perspective
- Must be able to undertake a thorough analysis of specific applications for technology choices, strategic decisions and innovation
- Must be able to analyze the possible methods to solve the problem, describe and assess the application of the chosen methods and how this influences the project results

**Competencies**
- Must be able to synthesize and describe the chosen problem and apply relevant theories, methods and experimental data
- Must have competencies in innovation and entrepreneurship within the field of ICT
- Must be able to contribute to the creative use of technologies to resolve user needs and improve organizational processes

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<th>Type of instruction:</th>
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<tr>
<td>The project is performed individually or in small groups of a maximum of three members. At least one internal supervisor is assigned, who works with the primary subject within his/her research. Moreover, additional supervisors e.g. from industry can be involved in the project.</td>
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<th>Exam format:</th>
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<tr>
<td>Oral examination based on a written thesis.</td>
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<tr>
<th>Evaluation criteria:</th>
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<td>Are stated in the Joint programme regulations.</td>
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</table>
3.3.2 Courses at 3rd trimester

Course module:
- Elective for all tracks
  Identity and Access Management
  (Identitets- og adgangshåndtering)

Objectives:
Students who complete the module:

Knowledge
- Must be able to explain the concepts of attributes, claims, assertion and claims-based identities
- Must be able to explain the concepts of security, privacy and trust
- Must have knowledge about the principles and methods for access control, authentication, authorization and identification
- Must be able to explain the key concepts and principles of identity management
- Must have knowledge of key management, certificates, tokens and credentials
- Must have knowledge about state-of-the-art principles and guidelines for protecting users’ privacy
- Must have knowledge of state-of-the-art technologies and frameworks for fine-grained management of personal attributes
- Must be able to understand the concepts of linkability and unlinkability and state-of-the-art principles for establishing trust
- Must have knowledge about security architectures, including policies and policy management
- Must have knowledge of national identity management frameworks such as NemID

Skills
- Must be able to discuss the differences between physical identities and online digital, virtual and partial identities
- Must be able to identify the personal attributes that are needed to perform a given task
- Must be able to apply methods for privacy protection, encryption, access control, authentication and authorization as a part of service development, including privacy by design principles
- Must be able to apply state-of-the-art technologies for realizing advanced services with privacy protection, e.g. OAuth and OpenID Connect
- Must be able to analyse and design information flow and architectures for secure ICT services and solutions
- Must be able to design applications and services incorporating security elements (e.g. payment, authentication), different assurance levels, and management of user identities (authentication, authorization, privacy protection)

Competencies
- Must have the competency to design secure services and security architectures with controlled exchange of attributes between stakeholders and minimal disclosure of personal information
- Must be able to discuss and reflect on management of personal information for access to resources and for personalization of services

Type of instruction: Types of instruction are listed in Chapter 3.

Exam format: Individual oral or written examination.

Evaluation criteria: Are stated in the Joint programme regulations.
### Course module:
- Elective for all tracks

**Markets, Regulation and Standardization**
(Markeder, regulering og standardisering)

### Objectives:
Students who complete the module:

**Knowledge**
- Must have knowledge on trends in ICT infrastructure and service markets
- Must have knowledge on tools and methods to analyse market developments
- Must have knowledge on the drivers and implications of ICT convergence
- Must have knowledge on the basic economics of Internet
- Must have knowledge on governance issues regarding Internet
- Must have knowledge on central regulatory issues concerning ICT infrastructures and services
- Must be able to understand the importance and role of standards, standardization organizations and standardization processes
- Must have knowledge on the relationships between innovation and standardization

**Skills**
- Must be able to critically assess a market analysis of ICT infrastructure and service markets
- Must have the ability to analyse the interplay between technology and market convergences in the ICT area
- Must be able to evaluate analyses of the economics of Internet
- Must be able to understand analyses of Internet governance issues
- Must be able to perform an analysis of the implications of regulatory initiatives regarding ICT infrastructures and services
- Must be able to apply theories on network economics, information economics, and transaction costs on standardization issues

**Competencies**
- Must have competencies in using tools and methods for market analysis
- Must have competencies in taking advantage in service and business developments of knowledge on converging ICT markets
- Must have competencies in guiding and managing analyses of the implications of Internet economics and governance on service business development
- Must have Competencies in understanding how regulations of ICT markets will affect market developments
- Must have competencies to outline the role of standards in business developments in the ICT area

### Type of instruction:
Types of instruction are listed in Chapter 3.

### Exam format:
Individual oral or written examination.

### Evaluation criteria:
Are stated in the Joint programme regulations.
Chapter 4: Effective date, interim regulations and revision

The curriculum adopted by the Study Board of Electronics and IT and approved by the Dean of the Faculty of Engineering and Science and comes into force on September 2016.

Students who wish to complete their studies under the previous curriculum from the Master in Information and Communication Technologies must conclude their education by the summer examination period September 2017 at the latest, since examinations under the previous curriculum are not offered after this time.

A valid version of the curriculum is published at www.sict.aau.dk.

Chapter 5: Other regulations

5.1 Rules for written assignments, including the master’s thesis project and its scope

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 should include a summary in a foreign language (English, French, Spanish or German with the approval of the study board). If the project is written in a foreign language (English, French, Spanish or German), the summary can be written in Danish with the approval of the study board. The summary should be at least 1 and at most 2 pages (not included in the possible fixed minimum and maximum number of pages per student). The summary is included in the overall evaluation of the project.

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

Students with other programme modules from other master programmes can earn credit / admission according to the study board’s assessment of the individual application (accreditation).

5.3 Examination rules

Examination rules are included in the faculty’s examination regulation which is published at the faculty’s website.

5.4 Exemption

The study board can in special circumstances grant exemption from those parts of the study board’s regulations, which are not laid down by law or ministerial order. Exemptions concerning examinations are valid from the following examination.

5.5 Rules for when the students should at the latest have completed their education after its commencement

The master programme should be completed at the latest 4 years, excluding leave of absence, after its commencement.

5.6 Additional information

The current version of the curriculum is published on the website of School of Information and Communication Technology (SICT), http://www.sict.aau.dk, including more detailed information about the programme and exams.