

## Chapter 9

The programme specific part of the curriculum for:

**MASTER OF SCIENCE (MSc) IN ENGINEERING  
(SOFTWARE ENGINEERING)  
(Civilingeniør, Cand. Polyt. i Software Engineering)**

**Curriculum 2017, Version 1.0**

**Applicable to students admitted September 2017 onwards**

The curriculum is divided into general provisions (Chapters 1-8), a programme specific part (Chapter 9) and the module descriptions of the programme's individual course modules. Students should familiarise themselves with all three parts in order to get a complete overview of the provisions regulating the programme.

## §1 Job Profiles

With an extensive knowledge in the field of software engineering the graduate engineer in Software Engineering is qualified for a wide variety of jobs in many different industries that use, integrate and develop software or products incorporating software. It could, for example, be in industry, finance, health, defence and security, telecommunications, transport, education, or administration.

Graduates are qualified for work in companies and organisations that develop software, including large and complex software systems. The graduate is qualified to independently take responsibility for and contribute to software development; i.e. the development of new software and customisation, integration and further development of existing software. The graduate is qualified to consider the technological, user-oriented as well as the organisational aspects of software development.

With the programme's emphasis on innovation and internationalisation, the graduate will also appeal to the many companies that develop software in a global context and use software as the basis for innovation and product development.

The graduate engineer will be qualified for a range of job functions in public and private companies, such as executive functions as software developer, system developer, system designer, system integrator, IT and system architect, product manager; organisational functions such as project manager, software quality engineer, IT strategy manager, head of project; or consulting functions such as IT consultant or system consultant. Furthermore, the graduate is qualified for jobs in research and education, for example scientific research assistant or teacher. Especially well-qualified graduates will be able to continue as PhD students in a relevant research field.

## §2 Competence Profile

### **Purpose of the MSc in Software Engineering**

The purpose of the MSc in Engineering (Software Engineering) is to, on a scientific basis, educate engineers who can independently take responsibility for and contribute to the development of new software as well as to the customisation, integration and further development of existing software in a way that considers scientific theories in the subject field, user-oriented and organisational aspects, software as an innovative element, and the impact of globalisation on software and software development (and vice versa).

The graduate must be able to independently take responsibility for and participate in the investigation of the need for the software, identification of requirements, analysis, software design, interaction design, programming and testing, as well as project management, change and configuration management, and quality management.

The graduate must be able to work systematically with large and complex software systems to control functionality (incl. security), life cycle, and software qualities important to operations (incl. user-friendliness), software development and software maintenance.

The graduate must be able to organise a well-defined process resulting in a software product with the right qualities, to the right price and at the right time. The graduate must be able to develop and deliver quality software as project manager, through individual work and as part of a team. Moreover, he or she must be able to reconcile conflicting project objectives and find acceptable compromises with limitations such as costs, time, knowledge, existing systems, organisation and environment.

### **Engineering competencies**

The programme is structured in accordance with the educational concept 'The Engineering Education Model of the University of Southern Denmark' or, in Danish, 'Den Syddanske Model for Ingeniøruddannelser' (DSMI). DSMI is based on a pedagogical/didactic approach which promotes a learning environment where students during their studies acquire a variety of engineering competencies in addition to the knowledge, skills and competences related to the specific programme.

The engineering competencies that characterise the MSc in Engineering programme builds on the engineering competencies acquired on the bachelor programme.

### **Knowledge, skills and competencies within the scientific fields related to the programme**

The competencies characterising the MSc in Software Engineering are based on and improve the skills acquired on the bachelor programme in software engineering.



<b>MASTER OF SCIENCE IN SOFTWARE ENGINEERING</b>	SM1-SEM (1. sem)	SM-SCM (1. sem)	SM2-MAS (1.sem)	SM1-DSC (1. sem)	SM2-MSD (2. sem)	SM2-UCI (2. sem)	SM-ISS (3. sem)	SMSP30/40 (3./4. sem)
evaluate and select among the scientific theories, methodologies, tools and general skills of data science, and set up new analysis and solution models on a scientific basis				X				X
evaluate and select among the scientific theories, methodologies, tools and general skills of software eco systems, and set up new analysis and solution models on a scientific basis					X			X
evaluate and select among the scientific theories, methodologies, tools and general skills of intelligent software, and set up new analysis and solution models on a scientific basis						X		X
communicate research-based knowledge and discuss professional and scientific issues related to data science with both peers and non-specialists				X				X
communicate research-based knowledge and discuss professional and scientific issues related to software ecosystems with both peers and non-specialists					X			X
communicate research-based knowledge and discuss professional and scientific issues related to intelligent software with both peers and non-specialists						X		X
analyse conditions and obstacles to the development of innovative solutions to societal problems and effectively carry out its implementation							X	X
analyse problems of social relevance and develop software solutions that contribute to solving these problems							X	X
analyze, understand and demonstrate methods and techniques to overcome common challenges in modelling and simulation			X					
<b>COMPETENCES</b>								
master science-based methods and tools for systematic development and maintenance of large and complex software systems of an international standard	X							X
masters methods of survey design to evaluate the effect of software solutions in the problem domain		X		X				X

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masters methods to assess the effect and value of solutions to non-trivial problems as well as compare and choose between alternative solutions		X		X				X
manage work situations and developments that are complex, unpredictable and require new solution models related to data science				X				X
manage work situations and developments that are complex, unpredictable and require new solution models related to software ecosystems					X			X
manage work situations and developments that are complex, unpredictable and require new solution models related to intelligent software						X		X
independently initiate and carry out discipline-specific and interdisciplinary collaboration and assume professional responsibility related to data science				X				X
independently initiate and carry out discipline-specific and interdisciplinary collaboration and assume professional responsibility related to software ecosystems					X			X
independently initiate and carry out discipline-specific and interdisciplinary collaboration and assume professional responsibility related to intelligent software						X		X
independently take responsibility for own professional development and specialization related to data science				X				
independently take responsibility for own professional development and specialization related to software ecosystems					X			
independently take responsibility for own professional development and specialization related to intelligent software						X		
facilitate innovation processes and assess the level of innovation in products and services through novelty searches in patent and research databases in the relevant subject fields							X	
masters analytical methods to examine and uncover socio-technological contexts in socially relevant issues where interaction between technology and society are deciding factors in the development of usable solutions							X	
manage and participate in global and multicultural development projects							X	

<b>MASTER OF SCIENCE IN SOFTWARE ENGINEERING</b>	SM1-SEM (1. sem)	SM-SCM (1. sem)	SM2-MAS (1.sem)	SM1-DSC (1. sem)	SM2-MSD (2. sem)	SM2-UCL (2. sem)	SM-ISS (3. sem)	SMSP30/40 (3./4. sem)
manage and perform an innovation and development process that results in a novel product or service that addresses an existing or emerging market.							X	
plan major development projects in collaboration with other professions								X
acquire research results and translate them into new products and services								X
manage work situations and developments that are complex, unpredictable and require new solutions based on modelling and simulation			x					

## §3 The Subjects of the Study Programme

The study programme consists of following subject areas:

- Modelling and Simulation
- Mobile and Ubiquitous Computing
- Software Ecosystems
- Data Science
- Innovative Software Solutions

### **Modelling and Simulation**

Modelling and Simulation is the most widely used operations research / systems engineering technique for designing new systems and optimizing the performance of existing systems. In one way or another, just about every engineering or scientific field uses simulation as an exploration, modeling, or analysis technique. The subject area is included to provide students with basic knowledge of modeling and simulation approaches and experience of using them to solve real problems.

### **Mobile and Ubiquitous Computing**

Mobile and ubiquitous computing considers how computing evolves into the fabric of everyday life by being mobile for people on the move or being embedded in their everyday surroundings. Therefore software has to be designed for and consider the interactions and continuous changes in the physical world and adapt to user intentions and context. Furthermore, software has to manage the availability, operation and reliability of resources including processing units, battery power, and user interaction, communication, sensing and actuation technologies. Key challenges include the development of flexible, scalable and decentralized applications embedded in a heterogeneous environment of resources, services and systems, e.g., in an Internet of things.

### **Software Ecosystems**

Software exists in an ecosystem of applications, systems and resources. Successful software has to be designed for and consider the interactions and continuous changes in ecosystems of software. Software has to manage the availability and security of resources including processing units, user interaction, communication, sensor and actuation technologies. A key challenge is the development of flexible, scalable and decentralized applications embedded in software ecosystems.

### **Data Science**

Data science is the extraction of knowledge from data. In particular it focuses on the collection, filtering, processing, creation and distribution of data. Dramatic growth in the scale and complexity of data that can be collected and analyzed is affecting all aspects of work and society. This implies that development of effective and ethical ways of using vast amounts of data is a significant challenge to science and to society as a whole. Therefore, the key challenge of data science is developing scalable techniques for data analysis and decision making, which requires interdisciplinary research in many areas, including machine learning,



algorithms, statistics, operations research, databases, complexity analysis, visualization, and privacy and security.

### **Innovative Software Solutions**

Software enables the creation of new and unforeseen solutions to automation of activities and processes that was not possible with mechanical or analogue technologies. It is playing an increasing role in realizing innovation, and also requires a radical shift in the mindsets of people to understand and explore the endless possibilities. New innovative software solution is demanded to addresses the societal challenges of the 21st century for an existing or emerging market.

## §4 Programme Structure

The programme consists of three parts:

- Compulsory part
- Elective part
- Master Thesis

The compulsory part consists of compulsory modules, which constitute the programme and its special professional skills and identity within the field of software engineering. The compulsory modules are introductory, core or advanced.

The elective part consists of modules, which students are free to choose.

The Master thesis synthesizes the students' skills in a specialized contemplation of a particular theme within software engineering.

4 <sup>th</sup> semester	Master Thesis*	
3 <sup>rd</sup> semester	Compulsory Part, Advanced	Elective Part
2 <sup>nd</sup> semester	Compulsory Part, Core	
1 <sup>st</sup> semester	Compulsory Part, Core	

## §5 Programme Structure and Modules

Semester	Struktur																													
4.	Master Thesis																													
3. (a) eller	Study abroad at a partner university <sup>1</sup>																													
3. (b)	SM-ISS Innovative Software Solutions										Elective/ In-company period <sup>2</sup>					Elective/ In-company period/ Master Thesis <sup>2</sup>					Elective/ In-company period/ Master Thesis <sup>2</sup>									
2.	SM2-UCI Ubiquitous Computing and Internet of Things										SM2-MSD Model-Driven Software Development										Elective					Elective				
1.	SM1-SEM Software Engineering of Mobile Systems										SM1-DSC Data Science										SM1-SCM Scientific Methods					SM1-MAS Modelling and Simula- tion				
ECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

1) Students are encouraged to complete the 3rd semester at a foreign university. Please note that the courses must be approved by the Academic Study Board of the Faculty of Engineering.

2) If the thesis is of an experimental nature, the student may choose to use the elective 10 ECTS on the 3rd semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS. Students on a 4+4 PhD programme may use their 15 ECTS electives on third semester together with the 30 ECTS on fourth semester on a 45 ECTS master thesis. If the student selects the In-company Period, the student is not able to do a 40 ECTS thesis, because the entire 15 ECTS electives on the third semester are spent on the In-company Period.

Colour codes	Compulsory courses	Elective courses	Study abroad
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## §6 Semester Description

### Compulsory part

*Core modules:* The core modules are in the 1st and 2nd semester. Students' knowledge and practice in software engineering of mobile systems and project management is consolidated in the module "Software Engineering of Mobile Systems". Furthermore, through the core modules Ubiquitous Computing and Internet of Things, Model-driven Software Development, Scientific Methods, Modeling and Simulation and Data Science, students dive into selected subject areas in essential and highly relevant software engineering research fields. Students also have the opportunity to gain deeper knowledge, skills and competencies through projects spanning the afore-mentioned subject areas.

*Advanced modules:* Through the advanced module students gain a complete collection of techniques for incremental and iterative development of large software projects and obtain competencies to perform innovation and development processes that result in novel products or services that address an existing or emerging market. The advanced modules are in the 3rd semester.

### Elective part

The elective part consists of modules, which students are free to choose. The elective modules are In-Company Period module and a pool of elective modules. The In-Company Period module enables the students to work part-time for a company as part of their 3rd semester.

#### *In-Company Period*

The In-Company period provides students with knowledge and understanding of practical situations, methods, processes and engineering functions of a company and enables them to apply their academic knowledge as well as prepare them for a future employment as graduate engineers.

### The Master Thesis

The Master Thesis demonstrates students' complete engineering skills in a relevant, limited, engineering subject within software engineering

## §7 Entry Requirements

### 7.0 English language skills

Native English-speaking applicants or applicants with a bachelor degree taught exclusively in English do not have to provide evidence of their English language skills.

Non-native English speaking applicants from a country within the European Union or the EEA are not required to pass an IELTS or a TOEFL test, if they can demonstrate knowledge of English corresponding with English at B level, as a minimum.

Applicants from a country outside the European Union or the EEA, however, must pass an IELTS or a TOEFL test with a minimum result of 6.5 in the IELTS test or a minimum result of 88 in the TOEFL test.

For further details, please refer to the University website.

### 7.1 Level and content of qualifying degrees

To be considered for admission applicants must have a relevant bachelor of science, bachelor of science in engineering, or bachelor of engineering degree.

For a degree to be relevant it must cover the below subject areas related to software engineering:

<u>Subject knowledge</u>	<u>Extent</u>
Software Development and Programming	20 ECTS
Operating Systems	5 ECTS
Distributed Systems and Networking	5 ECTS
Database Systems	5 ECTS
Algorithms and Data Structures	5 ECTS
Statistics	5 ECTS

### 7.2 Additional courses

Should the applicant's degree fail to meet the requirements mentioned in 7.1, it is possible to acquire the necessary skills through supplementary courses offered at the University of Southern Denmark. The extent of supplementary courses cannot exceed 5 ECTS.

Supplementary courses must be taken after admission to the programme and during the first semester. The supplementary activities must be passed within the examination period of the ordinary examination and students will have only two examination attempts.

### 7.3 Admission with a foreign degree

Applicants with a bachelor degree from a foreign university who meet the requirements of 7.1 are eligible for admission subject to an academic assessment and comparison of whether the applicant's academic qualifications correspond to those of qualifying Danish degree.

#### **7.4 Qualifying degrees**

The university has assessed that the below degrees qualify for admission to Master of Science in Engineering (Software). The list is not exhaustive:

Following degrees qualify for admission:

- BSc in Engineering (Software Engineering) – University of Southern Denmark (legal entitlement for admission)

#### **7.5 Possible exemptions**

Applicants whose bachelor degree fails to meet the above-stated terms are not eligible for admission.

Applicants who do not hold a bachelor degree but who have the academic qualifications equivalent thereto are eligible for admission should their qualifications, based on an academic assessment and comparison, correspond to those of a qualifying Danish degree.

## **§8 External Examiners and Study Board**

The study programme belongs under the Academic Study Board of the Faculty of Engineering and the Danish corps of external examiners for engineering programmes. Modules offered by the Faculty of Science belong under the corps of external examiners for science.

## **§9 Entry into Force**

1. Approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 18 April 2013.
2. Curriculum 2014 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 23 June 2014 (Version 1.0)
3. Curriculum 2015 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 18 March 2015 (Version 1.0).
4. Amendments approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 20 October 2015 (Version 1.1).
5. Curriculum 2016 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 25 May 2016 (Version 1.0).
6. Curriculum 2017 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 18 April 2017 (Version 1.0).