

Chapter 9

The programme-specific section of the Curriculum for the programme:

CIVILINGENIØR, CAND. POLYT. I ROBOTTEKNOLOGI

Master of Science in Robot Systems Engineering

Programme starting September 2012, Version 1.2

Please note that this version is a translation from Danish. In the event of discrepancies or ambiguity between this translation and the Danish version, the Danish version shall prevail.

The Curriculum is divided into a section with general provisions (Chapters 1-8), a programme-specific section (Chapter 9), and a section with descriptions of the programme's individual course modules. The student is advised to examine all three sections in order to get a complete overview of the provisions regulating the programme.

§1 Job profiles

The development in robot systems engineering requires engineers capable of working creatively across industrial disciplines and within research.

The Master's programme in Robot Systems Engineering ensures a broad research-based study of robotics-related areas like: computer vision, applied mathematics, artificial intelligence, software development and embedded systems. The breadth of the disciplines included in the programme provides the student with the skills and expertise required to make the robots of the future for production and service.

Graduates are employed mainly for research and development assignments in development-intensive manufacturing, service and consulting companies.

A Master of Science in Robot Systems Engineering works primarily in the private sector. In overall terms, a Master of Science in Robot Systems Engineering works with:

- Research and development
- Implementation of research methodologies and research results
- Entrepreneurship and innovation
- Counselling and project management

Within

- The robotics industry
- Welfare technology
- Image processing
- Embedded systems
- General software system engineering
- Mobile phones and web applications
- Mechanical engineering
- Security systems

§2 Skills profile for the programme

After successfully completing the Master of Science in Robot Systems Engineering programme, the graduate is able to accomplish technical research and development assignments within the field of computer engineering in general and the field of robot systems engineering in particular.

After successfully completing the programme, the core skills acquired by the graduate will consist in:

- the ability to use the scientific methodologies and tools of robot systems engineering, and use the general skills associated with work within this profession
- the ability to assess and select among the scientific theories, methodologies, tools and general skills of robot systems engineering and establish new models for analysis and problem solving on a scientific basis
- the ability to communicate research-based knowledge and discuss professional and scientific problems with both colleagues and non-specialists
- the ability to manage work and development conditions which are complex and unpredictable and require development of new problem solving models
- the ability to independently initiate and implement professional and interdisciplinary co-operation and assume professional responsibilities
- the ability to independently assume responsibility for his/her own professional development and specialisation
- a broad research-based knowledge of robot systems engineering and computer engineering within all the profiles of the education
- a knowledge based on international research of the highest level within one or more of the study profiles
- the ability to scientifically reflect on the knowledge acquired and identify scientific problems within the areas of robot systems engineering and computer engineering
- the required qualifications to apply for and commence a PhD programme.

§3 Specialisations of the programme

The programme has five specialisations (profiles/technical pillars) and a constituent part.

Constituent part:

- Scientific methodology
- Fundamental artificial intelligence
- Agent-oriented programming
- Image processing
- Introduction to robot systems
- Introduction to embedded systems
- Robot system design

Specialisation: Robotics

- Kinematics
- Robot system and automation engineering
- Mathematical modelling of industrial systems
- Computer simulation and animation

Specialisation: Artificial Intelligence

- Classic artificial intelligence
- "Behaviour-based" artificial intelligence
- Neural networks
- Generic algorithms
- Adaptive robots
- Bio-inspired robots

Specialisation: Software System Engineering

- Advanced theory on programming languages
- Software architecture
- Agent-oriented programming
- Software System Engineering for pervasive and ubiquitous computing systems

Specialisation: Embedded systems

- Programmable electronics
- Hardware/software co-design
- Hardware-near programming

- Data communication

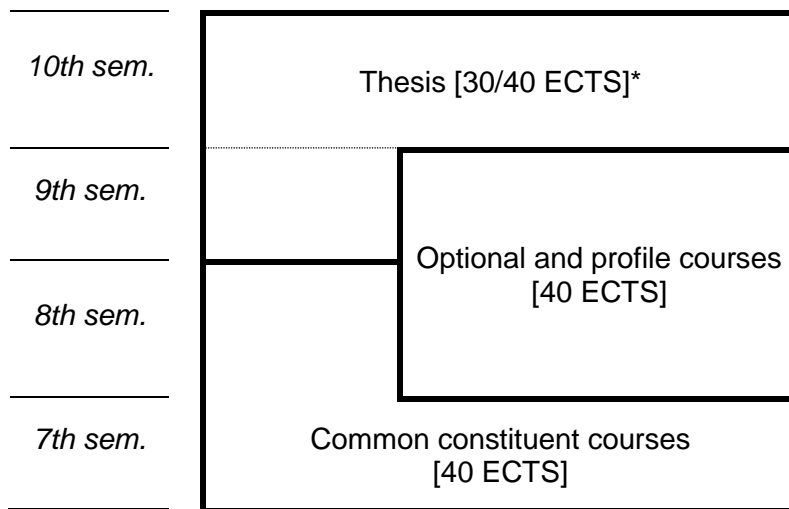
Specialisation: Computer vision

- Image processing
- Object recognition
- Real-time tracing of dynamic objects
- 3D Kalman filtering
- Robot assembly vision

§4 Programme structure

The programme consists of three elements:

- Common constituent courses which are mandatory for all students and intended to provide the students with a broad common skills platform within the field of robot systems engineering.
- Optional courses and profile courses intended to define the individual student's technical profile and equip the student with the skills required to write a specialised thesis within a given area.
- The thesis intended to synthesise the student's skills in a specialised contemplation of a particular theme within robot systems engineering.



*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

The student acquires research-based skills within all five profiles.

In addition, the student acquires skills based on international research at the highest level within at least one of the five profiles.

§5 Programme structure and modules

Specialisation: Robotics

Semester	STRUCTURE																													
10th	Thesis																													
9th	Optional courses/Thesis*					Optional courses										RMROB3 Profile course in robot systems engineering														
8th	RMRS1 – Robot system design					Optional courses										RMROB2 Advanced robot systems engineering					RMVIS2 Computer vision									
7th	RMEMB0/RMEMB1 Embedded systems					RMSCM1 Scientific methodology					RMVIS1 Image processing					RMA11 Introduction to artificial intelligence					RMROB1 Introduction to robotics					RMSSE1 Agent-oriented programming				
ECTS POINTS	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

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

Specialisation: Artificial Intelligence

Semester	STRUCTURE																													
10th	Thesis																													
9th	Optional courses/Thesis*										Optional courses										RMAI4 – Artificial intelligence project									
8th	RMRSD1 – Robot system design										Optional courses										RMAI2 Tools of artificial intelligence					RMAI3 Adaptive robots				
7th	RMEMB0/RMEMB1 Embedded systems					RMSCM1 Scientific methodology					RMVIS1 Image processing					RMAI1 Introduction to artificial intelligence					RMROB1 Introduction to robotics					RMSSE1 Agent-oriented programming				
ECTS POINTS	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

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

Specialisation: Software System Engineering

Semester	STRUCTURE																													
10th	Thesis																													
9th	Optional courses/Thesis*										Optional courses										RMSSE5** or RMEMB4***									
8th	RMRSD1 – Robot system design										Optional courses										RMSSE2 Progr. language, descr., execution					RMSSE3**** or RMSSE4*****				
7th	RMEMB0/RMEMB1 Embedded systems					RMSCM1 Scientific methodology					RMVIS1 Image processing					RMAI1 Introduction to artificial intelligence					RMROB1 Introduction to robotics					RMSSE1 Agent-oriented programming				
ECTS POINTS	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

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

**RMSSE5 – Software innovation in a societal context;

***RMEMB4 – Software aspects of embedded systems

**** RMSSE3 – Advanced software technologies for knowledge management;

*****RMSSE4 – Data mining.

Specialisation: Embedded Systems

Semester	STRUCTURE																													
10th	Thesis																													
9th	Optional courses/Thesis*										Optional courses										RMEMB4 – Software aspects of embedded systems									
8th	RMRSD1 – Robot system design										Optional courses										RMEMB2**					RMEMB3 Advanced programmable electronics				
7th	RMEMB1 Embedded systems					RMSCM1 Scientific methodology					RMVIS1 Image processing					RMAI1 Introduction to artificial intelligence					RMROB1 Introduction to robotics					RMSSE1 Agent-oriented programming				
ECTS POINTS	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

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

**RMEMB2: Signal integrity and high-speed digital systems.

Specialisation: Computer vision

Semester	STRUCTURE																													
10th	Thesis																													
9th	Optional courses/Thesis*					Optional courses										RMVIS3 – Advanced subjects of computer vision														
8th	RMRSD1 – Robot system design					Optional courses										RMVIS2 Computer vision					RMROB2 or RMAI2**									
7th	RMEMB0/RMEMB1 Embedded systems					RMSCM1 Scientific methodology					RMVIS1 Image processing					RMAI1 Introduction to artificial intelligence					RMROB1 Introduction to robotics					RMSSE1 Agent-oriented programming				
ECTS POINTS	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

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 9th semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS.

**RMROB2: Advanced robotics; RMAI2: Tools of artificial intelligence

§6 Semester description for 7th semester

All modules taught during the 7th semester are mandatory for all specialisations and will present the different profiles of robot systems engineering to the student and introduce the student to the scientific methodology of the area.

The following modules are offered:

- RMAI1 – Introduction to artificial intelligence (5 ECTS)
- RMSSE1 – Software systems engineering (5 ECTS)
- RMSCM1 – Scientific methodology (5 ECTS).
- RMEMB1/RMEMB0 – Embedded systems (5 ECTS)
- RMVIS1 – Computer vision (5 ECTS)
- RMROB1 – Robot kinematics (5 ECTS).

The reason why both RMEMB0 and RMEMB1 are offered is that the enrolled students' existing knowledge of the field of electronics differs widely. This is addressed by offering the students a test in electronics at the start of the semester. Based on their score, they are advised to take either the RMEMB0 or the RMEMB1 course. For students wishing to specialise in embedded systems, RMEMB1 is mandatory.

Just as the student is not expected to finally decide on his/her specialisation at the time of application for admission, he/she is also not expected to make a final decision on it after the 7th semester. It is an important point that the student can wait until very late in the programme before choosing his/her specialisation.

§7 Module descriptions

The module descriptions associated with the Master's level of the robot systems engineering programme and which apply to the 7th semester for students enrolled in September 2012, can be found in the Course planning system under the courses offered for Autumn 2012.

§8 Semester description for 8th semester

The 8th semester is divided into three blocks of 10 ECTS points each:

- Mandatory module: RMRSD1 – Robot Systems Design (10 ECTS)
- Profile courses: each specialisation offers two mandatory modules
- Optional courses

The mandatory module, RMRSD1 – Robot Systems Design, can be seen for instance as an extension of RMSCM1 – Scientific methodology, as the module strengthens the student's skills in scientific work and research with a focus on interdisciplinary aspects.

Another purpose of the 8th semester is to strengthen the student's skills within one or two of the specialisations, as it is possible to choose the mandatory modules of another specialisation as optional courses, which in effect gives access to choose between two specialisations after the 8th semester.

Mandatory modules for the specialisations:

Robotics

RMROB2 – Advanced robot technology, Computer vision (5 ECTS) and RMVIS2 – Computer vision (5 ECTS).

Artificial intelligence:

RMAI2 – Tools of artificial intelligence (5 ECTS) and RMAI3 – Adaptive robots (5 ECTS).

Software systems engineering:

RMSSE2 – Programming languages, description and execution (5 ECTS) and RMSSE3 – Advanced software technologies for knowledge management (5 ECTS) or RMSSE4 – Data mining (5 ECTS).

Embedded systems:

RMEMB2 – Signal integrity and high-speed digital systems (5 ECTS) and RMEMB3 – Advanced programmable electronics (5 ECTS).

Computer vision:

RMVIS2 – Computer vision (5 ECTS) and RMAI2 – Tools of artificial intelligence (5 ECTS) or RMROB2 – Advanced robotics (5 ECTS).

§9 Module descriptions

The module descriptions associated with the Master's level of the robot systems engineering programme and which applies to the 8th semester for students enrolled in September 2013, can be found in the Course planning system under the courses offered for Spring 2013.

§10 Semester description for 9th semester

At the 9th semester, the student will have to finally choose his/her specialisation.

The thesis must be of either 40 ECTS or 30 ECTS. The former is recommended, and in that case, the project must be defined no later than by 1 October.

In addition, like the 8th semester, the 9th semester includes an optional block of 10 ECTS as well as a profile course of the same weight. Thus, if the student opts for a 30 ECTS thesis, there will be 10 ECTS left for another profile course, or, more commonly, for an individual study activity in co-operation with a researcher.

The profile courses are to be seen as the theoretical conclusion of a specialisation, however usually with a significant added element of practical, scientific work. The optional and profile courses are highly dynamic and are closely based on the institute's current research activities. Consequently, the course curriculum must be expected to change frequently. The current offer of optional and profile courses will be published in a course catalogue one month into the previous semester. Consequently, the spring modules offered will be known by 1 October, while the autumn modules offered will be known by 1 March.

Mandatory modules for the specialisations:

Robotics

RMROB3 – Profile course of robotics (10 ECTS)

Artificial intelligence:

RMAI1 – Artificial intelligence project (10 ECTS)

Software systems engineering:

RMSSE5 – Software innovation in a societal context, alternatively RMEMB4 – Software aspects of embedded systems (10 ECTS)

Embedded systems:

RMEMB4 – Software aspects of embedded systems (10 ECTS)

Computer vision:

RMVIS3 – Advanced subjects of computer vision (10 ECTS)

§10 Module descriptions

The module descriptions associated with the Master's level of the robot systems engineering programme and which applies to the 9th semester for students enrolled in September 2012, can be found in the course planning system under the courses offered for Autumn 2013.

§11 Semester description for 10th semester

In the 10th semester, the student will prepare a 30 ECTS thesis or continue the work on a 40 ECTS thesis, which commenced in the 9th semester.

As a rule, the thesis will be completed by a group consisting of two students.

The thesis is required to be closely related to the chosen specialisation.

§12 Module descriptions

The module description for the Master's thesis of the robot systems engineering programme for students enrolled in September 2012 is available in the course planning system under the courses offered for Spring 2014.

§13 Qualifying study programmes

1. Bachelor programmes with immediate eligibility for admission (*Retskravs bachelor*)

Bachelors of Robot Systems Engineering (civil engineering programme)

Bachelors of Robot Systems Engineering from the Faculty of Engineering at the University of Southern Denmark are immediately eligible for admission.

2. Other qualifying bachelor programmes from the University of Southern Denmark

Bachelor of Engineering in Information and Communication technology

Bachelors of Engineering in Information and Communication technology from the Technical Department at the University of Southern Denmark may be admitted to the programme's Software System Engineering course profile.

Bachelors of Electrical and Electronic Engineering (computer engineering).

Bachelors of Electrical and Electronic Engineering (computer engineering) from the Faculty of Engineering at the University of Southern Denmark are immediately eligible for admission to the programme.

Bachelors of Electrical and Electronic Engineering (electronic engineering).

Bachelors of Electrical and Electronic Engineering (electronic engineering) from the Faculty of Engineering at the University of Southern Denmark may be admitted to the programme's Embedded Systems course profile, provided the applicant has successfully completed the optional courses of Software system engineering and Numerical analysis.

Bachelors of Mechatronics

Bachelors of Mechatronics from the Faculty of Engineering at the University of Southern Denmark may be admitted to the programme. The specialisation lines available at the Master's level will depend on the specialisation and optional courses chosen at the Bachelor level.

Bachelors of Computer Science with optional courses of "Industrial Software Production".

Bachelors of Computer Science with optional courses of "Industrial Software Production" from the Faculty of Science at the University of Southern Denmark may be admitted to the programme's Software System Engineering course profile.

3. Other qualifying programmes, general

Bachelors and Bachelors of Engineering from other universities

Bachelors and Bachelors of Engineering from other Danish and foreign universities or applicants with a similar educational background may be admitted to the programme, provided their technical qualifications correspond to those of admission-eligible Bachelors or Bachelors of Engineering from the Faculty of Engineering at the University of Southern Denmark.

§ 14 Corps of Censors and the Academic Study Board

The programme belongs under the Academic Study Board of the programmes at the Faculty of Engineering and the national Corps of censors of the Engineering programmes.

§15 Effect and amendments

1. Approved by the Board of Studies for the programmes at the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 27 January 2011.
2. Admission 2012 approved by the Board of Studies for the programmes at the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 7 March 2012 (Version 1.0).
3. Amendments approved by the Board of Studies for the programmes at the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 13 April 2012 (Version 1.1).
4. Amendments approved by the Board of Studies for the programmes at the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 21 June 2012 (Version 1.2).