SYDDANSK UNIVERSITET

Chapter 9
The programme-specific part of the curriculum for the programme:

CIVILINGENIØR, CAND. POLYT. I ROBOTTEKNOLOGI
Master of Science in Engineering (Robot Systems)

Curriculum 2014, Version 1.0

Applicable to students admitted September 2014 onwards

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 four robotics-related areas: computer vision, applied mathematics, artificial intelligence, 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
- a knowledge based on international research of the highest level within one or more of the research areas
- 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 Specification of the programme

The programme has four profiles and a constituent part.

Constituent part:

- Scientific methodology
- Fundamental artificial intelligence
- Image processing
- Introduction to robot systems
- Introduction to embedded systems
- Robot system design
- Mechanical engineering for robotics
- Multivariate statistics

Research area: Robotics

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

Research area: Artificial Intelligence

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

Research area: Embedded systems

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

Research area: 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 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 synthesize the student's skills in a specialized 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 3rd semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS. The student also has the option of project/development work for a company on the 3rd semester. The extent of this work must be 15 ECTS all of which are taken from the elective pool, thus ruling out the possibility of a 40 ECTS thesis.

The student acquires research-based skills within all four profiles/research areas.

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

§5 Programme structure and modules

<table>
<tr><td>Semester</td><td colspan="30">STRUCTURE</td></tr>
<tr><td>4th</td><td colspan="30">Thesis</td></tr>
<tr><td>3rd</td><td colspan="5">Elective course /
Thesis /
In-company period*</td><td colspan="5">Elective course /
Thesis /
In-company period*</td><td colspan="5">Elective course /
In-company period*</td><td colspan="5">Elective course</td><td colspan="10">RMRSD
Robot System Design</td></tr>
<tr><td>2nd</td><td colspan="5">RMEMB3
Advanced Programmable Electronics</td><td colspan="5">RMAI2
Tools of Artificial Intelligence</td><td colspan="10">RMROVI2
Robotics and Computer Vision 2</td><td colspan="5">RMSCM
Scientific method</td><td colspan="5">Elective course</td></tr>
<tr><td>1st</td><td colspan="5">RMEMB1 Robot Electronics</td><td colspan="5">RMAI1
Introduction to Artificial Intelligence</td><td colspan="10">RMROVI1
Introduction to Robotics and Computer Vision</td><td colspan="5">RMMUST
Multivariate Statistics</td><td colspan="5">RMMECH
Mechanical Engineering for Robotics</td></tr>
<tr><td>ECTS POINTS</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
</table>

*If the thesis is of an experimental nature, the student may choose to use the optional 10 ECTS on the 3rd semester as part of the thesis. This will extend the scope of the thesis to 40 ECTS. The in-company period/project work is 15 ECTS (see above).

§6 Semester description for 1st semester

The modules taught during the 1st semester will present the different profiles of robot systems engineering to the student plus offer an advanced course in statistics and an introduction to robot relevant mechanical engineering.

The following modules are offered:

RMAI1 – Introduction to Artificial Intelligence (5 ECTS)
RMROVI1 – Introduction to Robotics and Computer Vision (10 ECTS)
RMEMB1 – Robot Electronics (5 ECTS)
RMMECH – Mechanical Engineering for Robotics (5 ECTS)
RMMUST – Multivariate Statistics (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.

§7 Semester description for 2nd semester

The 2nd semester is divided into the following parts:

RMAI2 – Tools of Artificial Intelligence (5 ECTS)
RMROVI2 –Robotics and Computer Vision 2 (10 ECTS)
RMEMB3 – Advanced Programmable Electronics (5 ECTS)
RMSCM – Scientific Method (5 ECTS)
Optional course or activity (5 ECTS)

The purpose of the 2nd semester is to strengthen the student's skills within all of the research areas, and to introduce the student to a number of advanced scientific methods.

§8 Semester description for 3rd semester

On the 3rd semester the following courses are offered

RMRSD – Robot System Design (10 ECTS)
Optional courses or activities (10 ECTS)
Optional initial phase of master thesis (10 ECTS)

On the 3rd semester, the student will have to make choices about the thesis. 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.

The module RMRSD, Robot Systems Design, can be seen as an extension of RMSCM – Scientific Method, as the module strengthens the student's skills in scientific work and research with a focus on interdisciplinary aspects.

In addition, the 3rd semester includes an optional block of 10 ECTS. Thus, if the student opts for a 30 ECTS thesis, there will be 10 ECTS left for an individual study activity in co-operation with a researcher.

The student has the option of working halftime (15 ECTS) for a company in the region. The work has to be related to ongoing research at the faculty, and if the student chooses this path, the thesis can only be 30 ECTS.

The optional 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 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.

§9 Semester description for 4th semester

On the 4th semester, the student will prepare a 30 ECTS thesis or continue the work on a 40 ECTS thesis, which commenced in the 3rd semester.

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

§10 Qualifying study programmes

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

BSc in Engineering (Robot Systems)

Bachelors of Science (BSc) in Engineering (Robot Systems) 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

BEng Electrical and Electronic Engineering

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

BEng in Mechatronics

Bachelors of Engineering in Mechatronics from the Faculty of Engineering at the University of Southern Denmark may be admitted to the programme depending on the specialisation and optional courses chosen at the bachelor level.

BSc in Engineering (Mechatronics)

Bachelors of Science (BSc) in Engineering (Mechatronics) from the Faculty of Engineering at the University of Southern Denmark may be admitted to the programme depending on the specialisation and optional courses chosen at the bachelor level.

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.

§ 11 Corps of Censors and Board of Studies

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

§12 Effect and amendments

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 27 January 2011.

2. Curriculum 2012 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 7 March 2012 (Version 1.0).

3. 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 13 April 2012 (Version 1.1).

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 21 June 2012 (Version 1.2).

5. Curriculum 2013 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 (Version 1.0).

6. 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 22 August 2013 (Version 1.1)

7. 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 13 November 2013 (Version 1.1)

8. 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 13 December 2013 (Version 1.2)

9. 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 22 January 2014 (Version 1.2)

10. 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).