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 2015, Version 2.0

Applicable to students admitted September 2015 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.

The master degree has two specialisations:

- Advanced robotics technology (ART)
- Unmanned aerial systems technology (UAS)

and the subsequent paragraphs/sections will, as a rule, be divided into two – one for each specialisation.

§1a Job profile – Advanced Robotics Technology

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 with specialization in Advanced Robotics Technology works primarily in the private sector. In overall terms he or she 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 and programming
- Mobile phones and web applications
- Mechanical engineering
- Security systems

§1b Job profile – Unmanned Aerial Systems Technology

The development in unmanned aerial systems (UAS) engineering (aka drone technology 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 basic robotics-related areas: computer vision, applied mathematics, artificial intelligence, and embedded systems applicated in drone systems including mechanical disciplines. The breadth of the disciplines included in the programme provides the student with the skills and expertise required to make the drones for the future.

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 with specialization in UAS Engineering works primarily in the private sector. In overall terms, he or she works with:

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

Within

- Aircraft navigation and path planning
- Autonomous behaviour
- Flight controllers
- Sensors and signal processing
- Image processing and computer vision
- Embedded systems
- Ground control systems
- Manipulators and actuators
- Aircraft software engineering
- Unmanned aircraft safety

§2a Competence profile - Advanced Robotics Technology

The master programme in robot systems engineering is a research based programme, which builds on the competence profile of the Bachelor of Science in Engineering (Robot Systems) or equivalent, qualifying bachelor degree. The master programme is prepared and conducted in accordance with ’The Engineering Model of the University of Denmark’ (DSMI). The goals and the competence profile are described in accordance with the Danish Qualification Framework’s descriptions of learning objectives within the categories *competences, skills* and *knowledge*. The table below outlines in which courses students obtain their qualifications with respect to knowledge, skills and competences.

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (ART) HAS …	RMAI1 (1. sem.)	RMEMB1 (1.sem.)	RMSCM1 (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMROVI2 (2. sem.)	RMMECH (2. sem)	RMRSD1 (3. sem.)	RMMT (3./4. sem.)
KNOWLEDGE OF											
Classical behaviour-based and embodied approaches to AI, state-space representational techniques, knowledge based action planning techniques and heuristics.	X										X
Analogue and digital electronic interfaces, sensors and actuators, state machines, FPGA, VHDL, communication interfaces.		X					X				X
Materials, Hooke’s law, deformation, static and dynamic performance of materials, 3D printing, range of components, spectrum design problems.									X		X
Multivariate: distributions, hypothesis testing, variance, linear regression; Principal Component analysis, Factor analysis; grouping and clustering of multivariate observations.				X							X
Principles of the geometry and kinematics in robot and vision systems, homogeneous transformation, camera-scene calibration, trajectory calibration, point-to-point robot planning algorithms; image characteristics, camera model and geometry, image and filtering operations, features and extraction processes, object recognition.					X						X

Machine learning techniques and their experimental challenges and demands.						X					X
VHDL coding style and layout, Xilinx ISE, Smart Compile, Schematic, Floorplanner, ModelSim, EDK, FPGA		(X)					X				X
Advanced algorithms for motion planning and path optimization, constrained and grasp planning, collision detection, shortest paths in dynamically changing graphs and robot dynamics								X		X	
Camera models and multi camera systems, matching of image areas, 3D reconstruction and pose estimation, object recognition and tracking, structure from motion.								X		X	X
Scientific methods used in different fields, literature search and organization, hypothesis generation and testing, statistical test and real world applications.			X								X
Safety requirements for robotics installation interface to MES layer, communication protocols with external equipment, OEE measurement, project planning and management with SCRUM, financial aspects of robot systems.										X	X

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (ART) HAS …	RMAI1 (1. sem.)	RMEMB1 (1.sem.)	RMSCM1 (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMROVI2 (2. sem.)	RMMECH (2. sem)	RMRSD1 (3. sem.)	RMMT (3/4. sem.)
SKILLS TO											
Design and implement solutions to non-trivial search-based problems, interface AI software and robotic components, devise simple but reliable robotic agents to support AI software..	X										X
Control an actuator, use interfaces for sensors and actuators, develop interfaces between analogue and digital electronics, and design interaction between hardware and software.		X									X

Use CAD tools and 3D printing equipment, specify actuator and transmission configurations and propose material and configurations for robotic applications.									X		X
Implement multivariate methods with relevant tool(s), calculate quantitative descriptive statistics for the methods and do inferential statistics for them.				X							X
Develop and use kinematic models for robots, position and rotation computation in 3D, handle camera calibration issues, represent robot tasks as trajectories, implement robot planning algorithms, use software tools for visualizing robots.					X					X	X
Apply image processing toolboxes, judge image degradation, select filters and apply them, select features for recognition, construct object recognition algorithms for 2D problems.					X					X	X
Implement AI techniques, devise suitable representations of data for machine learning techniques, and assess performance of machine learning techniques; write a scientific paper.						X					X
Write programs in programming languages such as HandelC, including localizing and mending timing problems.							X				X
Write algorithms for motion planning, path optimization and grasping, model the dynamics of a robot manipulator, and acquire new knowledge in course related research papers.			X					X			X
Extract 3D scene description using camera information, use 3D information for object recognition, pose estimation etc., and use redundant information to improve estimates.								X		X	X
Evaluate scientific papers, understand the value of standardization, benchmarking and controls, generate alternative explanations for experiments, validate research results by simple prototypes, understand the differences in methodologies across disciplines.			X							X	X
Understand the technological and architectural challenges by designing and implementing and integrating part of a robot system with multiple components, analyse problem and domain to determine										X	X

best practice, prepare and manage a project plan and perform a feasibility study.											

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (ART) HAS …	RMAI1 (1. sem.)	RMEMB1. (1.sem.)	RMSCM1 (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMROVI2 (2. sem.)	RMMECH 2. sem)	RMRSD1 (3. sem.)	RMMT (3./4. Sem.)
COMPETENCES TO …											
Recognize problems for state-based AI, choose tools and methods for representing an AI problem in a state-based formulation, and select a search/planning algorithm for a knowledge-based problem.	X										X
Develop a functional system and combining knowledge and experience from the course theory and practice, document technical results.		X									X
Communicate with mechanical engineers about the mechanical aspects of robot systems design and identify the areas of a robot system that requires mechanical engineering expertise.									X		X
Plan and design experiments in a multivariate setting, analyze data using multivariate methods, perform model check, summarize and visualize the results of an analysis and conclude, and identify and apply multivariate statistics in relevant robot systems related domains.				X							X
Solve tasks involving forward and inverse kinematics, point-to-point planning, basic robot calibration and trajectory design.					X						X
Solve simple 2D computer vision and image restoration problems.					X						X
Identify robotic problems for machine learning, characterize a new AI technique, and evaluate reported applications of machine learning techniques in terms of results and methodology.						X					X

Develop applications on FPGA, present results in a scientific journal documenting and verifying that the implemented applications perform as expected.							X				X
Solve problems within robot motion and task planning using state of the art methods and evaluate the results in a scientific manner.								X			
Solve 3D computer vision problems such as pose estimation, object tracking, structure from motion, 3D reconstructions and combinations thereof.								X			
Apply the correct methodology for the chosen scientific topic.			X								X
Implement an industrial robot installation.										X	X

§2b Competence profile – Unmanned Aerial Systems Technology

The master programme in robot systems engineering is a research based programme, which builds on the competence profile of the Bachelor of Science in Engineering (Robot Systems) or equivalent, qualifying bachelor degree. The master programme is prepared and conducted in accordance with 'The Engineering Model of the University of Denmark' (DSMI). The goals and the competence profile are described in accordance with the Danish Qualification Framework's descriptions of learning objectives within the categories *competences*, *skills* and *knowledge*. The table below outlines in which courses students obtain their qualifications with respect to knowledge, skills and competences.

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (UAS) HAS …	RMAI1 (1. sem.)	RMEMB1 (1.sem.)	RMSCM1 (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMURV2 (2. sem.)	RMUAST (2. sem.)	RMUASM (2. sem.)	RMUASD (3. sem.)	RMMT (3./4. sem.)
KNOWLEDGE OF												
Classical behavior-based and embodied approaches to AI, state-space representational techniques, knowledge based action planning techniques and heuristics.	X											X
Analogue and digital electronic interfaces, sensors and actuators, state machines, FPGA, VHDL, communication interfaces.		X					X					X
Aerodynamic properties, aircraft configuration and stability, propellers and rotors, and aircraft materials and mechanics..										X		X
Multivariate: distributions, hypothesis testing, variance, linear regression; Principal Component analysis, Factor analysis; grouping and clustering of multivariate observations.				X								X
Principles of the geometry and kinematics in robot and vision systems, homogeneous transformation, camera-scene calibration, trajectory calibration, point-to-point robot planning algorithms; image characteristics, camera model and geometry, image and filtering operations, features and extraction processes, object recognition.					X							X
Machine learning techniques and their experimental challenges and demands.						X						X

VHDL coding style and layout, Xilinx ISE, Smart Compile, Schematic, Floorplanner, ModelSim, EDK, FPGA		(X)					X					X
Advanced algorithms for motion planning and path optimization, constrained and landing planning, shortest paths in dynamically changing graphs.								X			X	X
Camera models, matching of image areas, 3D reconstruction and pose estimation, object recognition and tracking, structure from motion.								X			X	X
UAS: applications and current research; legislation; safety and risk assessment; airworthiness and certification; flight planning; related meteorology; platforms; flight controller hardware and software; navigation; wireless communication systems; power systems.									X			
Scientific methods used in different fields, literature search and organization, hypothesis generation and testing, statistical test and real world applications.			X									X
Unmanned aerial system design, safety and Danish legislative requirements for UAS applications, financial aspects of UAS applications and agile project management.											X	X

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (UAS) HAS …	RMAI1 (1. sem.)	RMEMB1 (1.sem.)	RMSCM1 (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMURV2 (2. sem.)	RMUAST (2. sem)	RMUASM (2. sem)	RMUASD (3. sem.)	RMMT (3/4. sem.)
SKILLS TO												
Design and implement solutions to non-trivial search-based problems, interface AI software and robotic components, devise simple but reliable robotic agents to support AI software.	X											X

Control an actuator, use interfaces for sensors and actuators, develop interfaces between analogue and digital electronics, and design interaction between hardware and software.		X										X
Perform basic aerodynamic calculations and basic structural calculations; choose/develop the most appropriate aerodynamic and structural configuration.										X		X
Implement multivariate methods with relevant tool(s), calculate quantitative descriptive statistics for the methods and do inferential statistics for them.				X								X
Develop and use kinematic models for robots, position and rotation computation in 3D, handle camera calibration issues, represent robot tasks as trajectories, implement robot planning algorithms, use software tools for visualizing robots.					X						X	X
Apply image processing toolboxes, judge image degradation, select filters and apply them, select features for recognition, construct object recognition algorithms for 2D problems.					X						X	X
Implement AI techniques, devise suitable representations of data for machine learning techniques, and assess performance of machine learning techniques; write a scientific paper.						X						X
Write programs in programming languages such as HandelC, including localizing and mending timing problems.							X					X
Write algorithms for motion planning, path optimization and grasping, model the dynamics of a robot manipulator, test and document planning algorithms, adapt planning algorithms for specific use, path optimization, and acquire new knowledge in course related research papers.								X		X		X
Extract 3D scene description using camera information, use 3D information for object recognition, pose estimation etc., and use redundant information to improve estimates.								X			X	X
Apply robotics skills to the design and development of unmanned aircrafts; show an overall understanding of the applicability of UAS									X			

technology to problems in different domains.												
Evaluate scientific papers, understand the value of standardization, benchmarking and controls, generate alternative explanations for experiments, validate research results by simple prototypes, understand the differences in methodologies across disciplines.										X	X	X
Develop and follow a project plan based on agile principles, estimate the feasibility of implementing a UAS application in a real-life scenario using cost/benefit analysis as well as safety analysis, design and implement a UAS application consisting of an unmanned aircraft collaborating with other entities such as ground control, pilot etc., develop and integrate new aircraft and payload systems, interface to and extend the functionality of existing flight controller software.											X	X

THE GRADUATE IN ROBOT SYSTEMS ENGINEERING (UAS) HAS …	RMAI1 (1. sem.)	RMEMB1. (1.sem.)	RMSCM (1. sem.)	RMMUST (1. sem.)	RMROVI1 (1. sem.)	RMAI2 (2. sem)	RMEMB3 (2. sem.)	RMURV2 (2. sem.)	RMUAST (2. sem)	RMUASM (2. sem.)	RMUASD (3. sem.)	RMMT (3./4. Sem.)
COMPETENCES TO …												
Recognize problems for state-based AI, choose tools and methods for representing an AI problem in a state-based formulation, and select a search/planning algorithm for a knowledge-based problem.	X											X
Develop a functional system and combining knowledge and experience from the course theory and practice, document technical results.		X										X
Initiate and carry out work within the UAS field, including interdisciplinary collaboration and manage complex and unpredictable development within UAS; take personal responsibility for professional development and specialization within UAS.			X									X
Plan and design experiments in a multivariate setting, analyze data using multivariate methods, perform model check, summarize and				X								X

visualize the results of an analysis and conclude, and identify and apply multivariate statistics in relevant robot systems related domains.												
Solve tasks involving forward and inverse kinematics, point-to-point planning, basic robot calibration and trajectory design.					X							X
Solve simple 2D computer vision and image restoration problems.					X							X
Identify robotic problems for machine learning, characterize a new AI technique, and evaluate reported applications of machine learning techniques in terms of results and methodology.						X						X
Develop applications on FPGA, present results in a scientific journal documenting and verifying that the implemented applications perform as expected.							X					X
Solve problems within robot motion and task planning using state of the art methods and evaluate the results in a scientific manner.								X				X
Solve 3D computer vision problems such as pose estimation, object tracking, structure from motion, 3D reconstructions and combinations thereof.								X				X
Apply the correct methodology for the chosen scientific topic.			X									X
Participate in finding technical applicable solutions to the design and development of UAS subsystems and payload modules; contribute to the development in research and industrial UAS projects.										X		
Participate in UAS research and industrial projects focusing on development while understanding the interplay with safety, legislative, financial and project management aspects.											X	X

§3a Specification of Advanced Robotics Technology specialization

The ART specialization has a constituent part and relates to four different research areas.

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
- Motion and task planning
- 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

§3b Specification of Unmanned Aerial Systems specialization

The UAS specialization has a constituent par and relates to five different research areas.

Constituent part:

- Scientific methodology
- Fundamental artificial intelligence
- Image processing
- Robot systems
- Embedded systems
- Unmanned aerial system design
- Mechanical engineering for aircraft
- Multivariate statistics

Research area: Unmanned aerial systems:

- Flight controllers
- Aircraft navigation and path planning
- Ground control systems
- Payload sensor- and actuator platforms
- Reliable and redundant safety systems
- Aircraft software engineering
- Aviation legislation

Research area: Robotics

- Kinematics
- Robot system and automation engineering
- Motion and task planning
- 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
- Wireless communication systems (hardware and software)
- Motor control

Research area: Computer vision

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

§4 Programme structure

The structure of the master programme is such that it is a logical, academic extension of the bachelor programme. The first semester and the second semester contain mandatory courses in each of the four basic research areas, robotics, artificial intelligence, computer vision, and embedded systems. The courses on the first semester are accessible by way of the skills acquired in the areas of mathematics, physics, electronics, and programming on the bachelor programme. Specialization specific courses of the Unmanned Aerial Systems Technology specialization appear on the second and the third semester.

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.
- Specialization-specific courses that provide the students with the necessary skills of importance to the relevant research areas.
- 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 relevant research areas.

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

§5a Programme structure and modules – Advanced Robotics Technology

<table>
<tr><th>Semester</th><th colspan="30">Modules</th></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">RMRSD1
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">RMMECH
Mechanical
Engineering for
Robotics</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">RMSCM1
Scientific method</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. 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. The in-company period is 15 ECTS.

§5b Programme structure and modules – Unmanned Aerial Systems Technology

<table>
<tr><th>Semester</th><th colspan="30">Modules</th></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">RMUASD
Unmanned Aerial 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">RMURV2
Robotics and Computer Vision 2
for UAS</td><td colspan="5">RMUAST
Unmanned Aerial
Technology</td><td colspan="5">RMUASM
UAS-related
Mechanical
Engineering</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">RMSCM1
Scientific method</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. 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. The in-company period is 15 ECTS.

§6 Semester description for 1st semester

The 1st semester is identical for the two specializations.

The modules taught during the 1st semester will present the four basic research areas to the student plus offer a course in scientific method and an advanced course in statistics.

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)
RMMUST – Multivariate Statistics (5 ECTS)
RMSCM1 – Scientific Method (5 ECTS)

§7a Semester description for 2nd semester – ART specialization

The 2nd semester is divided into the following modules:

RMAI2 – Tools of Artificial Intelligence (5 ECTS)
RMROVI2 –Robotics and Computer Vision 2 (10 ECTS)
RMEMB3 – Advanced Programmable Electronics (5 ECTS)
RMMECH – Mechanical Engineering for Robotics (5 ECTS)
Optional course or activity (5 ECTS)

The purpose of the 2nd semester is to strengthen the student's skills within the research areas and to introduce the student to relevant aspects of mechanical engineering.

§7b Semester description for 2nd semester – UAS specialization

The 2nd semester is divided into the following modules:

RMAI2 – Tools of Artificial Intelligence (5 ECTS)
RMURV2 –Robotics and Computer Vision 2 for UAS (10 ECTS)
RMEMB3 – Advanced Programmable Electronics (5 ECTS)
RMUASM – UAS-related Mechanical Engineering (5 ECTS)
RMUAST – Unmanned Aerial Technology (5 ECTS)

The purpose of the 2nd semester is to strengthen the student's skills within the research areas and to introduce the student to relevant aspects of mechanical engineering.

§8 Semester description for 3rd semester

On the 3rd semester the following courses are offered

RMRSD1 – Robot System Design (10 ECTS) – ART Specialization
or
RMUASD – Unmanned Aerial System Design (10 ECTS) – UAS Specialization
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 RMRSD1/RMUASD can be seen as an extension of RMSCM1 – 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.

STUDY ABROAD
It is possible to spend third semester at a university abroad, provided the courses are approved by the Academic Study Board of the Faculty of Engineering.

§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, preferably in collaboration with the local industry.

§10 Qualifying degrees

10.1 Qualifying degrees
Based on 10.2 – 10.4 the university has assessed that the below degrees qualify for admission to Master of Science in Engineering (Robot Systems). The list is not exhaustive.

- BSc in Engineering (Robot Systems) – University of Southern Denmark (legal entitlement for admission)
- BEng in Electrical and Electronic Engineering (profile in Computer Engineering) – University of Southern Denmark
- BEng in Mechatronics – University of Southern Denmark
- BSc in Engineering (Mechatronics) – University of Southern Denmark

10.2 Level and content of qualifying degrees
Qualifying bachelor and professional bachelor degrees in the scientific and technical area where the level and content of the scientific and technical courses correspond to a bachelor of science degree or a bachelor of engineering degree in the subject area of the MSc in Engineering (Robot Systems) programme.

10.3 Academic content of qualifying degree
MSc in Engineering (Robot Systems) admits applicants with a bachelor degree or a professional bachelor degree in the subject area of the programme cf. 10.2 provided that the degree covers:

Subject knowledge	Extent
Software development and programming (C++)	20 ECTS
Electronics – analogue and digital	20 ECTS
Mathematics	20 ECTS
Physics and electrophysics	10 ECTS
Signal processing	10 ECTS

10.4 Additional courses
Should the applicant's degree fail to meet the requirements mentioned in 10.1 - 10.3, it is possible to acquire the necessary skills through additional courses offered at the University of Southern Denmark. The extent of additional courses cannot exceed 15 ECTS.

Additional courses have to be taken after admission to the programme. The courses can be taken during the first two semesters of the programme and must be passed by the end of the first year of study. Additional courses are restricted to courses offered by the University of Southern Denmark as summer courses or parallel to the first year of the master programme.

10.5 Admission with a foreign degree

Applicants with a bachelor degree or professional bachelor degree from a foreign university who meet the requirements of §10.2 and §10.3 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.

10.6 Possible exemptions

Applicants whose bachelor degree or professional bachelor degree fails to meet the terms stated in 10.1 – 10.5 are not eligible for admission.

Applicants who do not hold a bachelor degree or a professional 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.

Two-year transitional arrangement regarding additional courses:
Completed and passed additional courses, i.e. single courses from existing bachelor programmes, may be included in the application for admission until 31 August 2016.

§ 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. 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).

4. 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).

5. 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 27 January 2015 (Version 1.0).

6. 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 22 May 2015 (Version 2.0).