Programme syllabus

Master's Programme, Systems, Control and Robotics, 120 credits
Masterprogram, systemteknik och robotik

120.0 credits

Valid for students admitted to the education from autumn 09 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

The theme of the Master of Science programme in Systems, Control and Robotics is the analysis, design and construction of complex systems. In this spirit the programme brings together courses from both the School of Electrical Engineering (EES) and the School of Computer Science and Communication (CSC). The students of the programme should acquire the knowledge and understanding necessary when working with complex systems in different capacities both in academia and in industry.

Knowledge and understanding

For the master’s degree, the student should:

- have thorough knowledge of current theories and developments in the study area
- have thorough understanding of high competence in Systems and Control
- independently be able to identify and formulate problems related to Systems, Control and Robotics and with adequate methods be able to carry out qualified analysis.

Skills and abilities

Working with complex systems requires skills and abilities in a wide range of topics. For the master’s degree, the student should:

- acquire a broad base of skills in core technical subjects such as signal processing, control, estimation, programming, which are key to understanding complex systems
- have the ability understand problems that may not be within their area of specialization
- acquire skills in project management and the theory and methodology of science.

Ability to make judgements and adopt a standpoint

Equipped with the above mentioned skills and abilities, an objective is also to make the students able to:

- critically review the work of others and adopt a standpoint in different matters
- show the ability to, within the technical area, make judgments with regards to relevant scientific, social, and ethical aspects and show awareness about ethical aspects in research and development work
- show insight about technology’s possibilities and limitations, its role in society and humans’ responsibility for how it is used
- show the ability to identify his/her need for further knowledge and take responsibility for developing his/her knowledge. Additional information can be found in the KTH Handbook.

Extent and content of the programme

The programme is two years long, 120 higher education credits. The courses are mainly from the second cycle but some, mainly non-technical are from the first cycle. The language of instruction throughout the programme is English.
Eligibility and selection

Basic eligibility requirements for first or second level education:

- The student should have been awarded Bachelor of Science or Bachelor in Engineering degree from a university or polytechnic institute. The degree must correspond to at least 3 years of full-time academic studies i.e. 180 higher education credits. The main subject of the B. Sc. degree must have been studied in depth for at least 1.5 year. Also, the degree must include a dissertation corresponding to approximately 10 weeks of full-time work.
- Applicant must also have good oral and written skills in English. Applicants from outside the Nordic countries or from outside the European Union, and who do not have English as their native tongue, are required to have completed a TOEFL language test with a minimum score of 600 (245, for computer-based test, or 85, for internet-based test) or an IELTS test with minimum score of 6.5. It is also strongly encouraged to take the GRE test (Graduate Records of Examination).

The specific eligibility requirements

The student should have read courses equivalent to the following KTH courses:

- SF1624 Algebra and Geometry
- SF1625 Calculus in One Variable
- SF1626 Calculus in Several Variables
- SF1649 Vector Analysis and Complex Functions
- SF1901 Probability Theory and Statistics
- SF1635 Signals and Systems, part I
- EQ1100 Signals and Systems, part II
- EL1110 Automatic Control, General Course
- DD1343 Computer Science and Numerical Methods, part I

The specific eligibility requirements can be assessed as not-fulfilled if:
1. the average grade is less than 75% of the highest grade.
2. the degree awarding institution is not considered to meet acceptable quality standards by the authorities of the country in which the institution is located.
3. the degree does not qualify for admission to equivalent Master level in the country where the degree is awarded.

The selection process for Systems, Control and Robotics is based on a total evaluation of the following selection criteria: university, GPA, course work related to the programme and references. Please refer to the local admission policy of the Royal Institute of Technology (the KTH-handbook) for general admission and selection rules.

Implementation of the education

Structure of the education

The Academic year starts at the end of August and ends at the end of May/ beginning of June. The year is divided into two semesters, one in the autumn and one in the spring. Each of the semesters has two study periods. The study periods are about 7 weeks long and end in an exam period. In addition to the four exam periods at the end of the study periods there are three more exam periods, one after Christmas, one after May and one before the start of the Academic year. The programme starts with a number of obligatory courses during year 1 to assert a certain level of knowledge in the core areas of the programme and thus give the wide base needed to work with complex systems. During the first half of the second year the students can further specialize their studies and during the second half the degree project is carried out.

Courses

The programme is course-based. Lists of courses are included in appendix 1.

The programme is course-based. Lists of courses are included in appendix 1. During the first year the students can select optional courses corresponding to 16.5 higher education credits and during the second year 18 credits. Some of the elective courses have an upper limit for the number of seats and the students must compete with other students at KTH for these seats. Some of the courses do not run every year.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.
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**Conditions for participation in the programme**

Description of term enrolment. No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration. Course selection and prerequisites. No later than November 15 and May 15 each academic year, respectively, the students are required to make a course selection. Conditions for being promoted to the next level. In order to be registered for elective courses in Term 3, you must have completed at least 45 higher education credits of course work.

**Recognition of previous academic studies**

Under certain circumstances, and in agreement with the programme director, credits for previous studies can be received according to the local policy of KTH, see

http://www.kth.se/info/kth-handboken/II/13/3.html

**Studies abroad**

The Degree project (Master’s Thesis project) can be performed abroad providing the student has an advisor at KTH and one at the receiving institution and that the work follows the KTH regulations for a Thesis project. Exchange studies for course work abroad is not available.

**Degree project**

The objective of the degree project is to apply the knowledge that has been acquired during the course work in the programme and is thus carried out during the second year. The project corresponds to 30 higher education credits or one semester of full time work. Typically the first half of the second year is used to prepare for and specify the thesis project. To be eligible to commence a thesis project the student must have taken a minimum of 60 credits from the course list. The project can be performed either in industry, at a KTH department, or in another technical university or in a research institute. It is the responsibility of the student to find a thesis project and an examiner/supervisor for it. All projects must be approved by a KTH examiner. The degree project is graded, according to the A-F scale, based on three KTH-common assessment principles; engineering-related and scientific content, process and presentation. Reference the KTH-handbook 2, section 15.1-15.6.

**Degree**

Students who have successfully completed a two-year Master’s programme (120 ECTS) will be awarded a “Teknologie masterexamen”, translated into English as "Degree of Master of Science (two years)". For the degree, the following is required:

1. Complete all of the obligatory courses
2. Complement with elective courses for a total of 90 higher education credits
3. Complement at most one of the elective non-technical courses
4. Successfully completed degree project of 30 higher education credits.

Reference to the local degree policy (the KTH-handbook).

*Appendix 1 - Course list*

*Appendix 2 - Programme syllabus descriptions*
Appendix 1: Course list

Master's Programme, Systems, Control and Robotics, 120 credits (TSCRM), Programme syllabus for studies starting in autumn 2009

**General courses**

**Year 1**

**Mandatory courses (30.0 credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2423</td>
<td>Image Analysis and Computer Vision</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2310</td>
<td>Scientific Programming</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2320</td>
<td>Applied Estimation</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ1220</td>
<td>Signal Theory</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
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**Optional courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD1363</td>
<td>Software Engineering</td>
<td>12.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>DD2380</td>
<td>Artificial Intelligence</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2427</td>
<td>Image Based Recognition and Classification</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2428</td>
<td>Geometric Computing and Visualization</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2431</td>
<td>Machine Learning</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2432</td>
<td>Artificial Neural Networks and Other Learning Systems</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2447</td>
<td>Statistical Methods in Applied Computer Science</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2230</td>
<td>Fast Numerical Algorithms for Large-Scale Problems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2266</td>
<td>Mathematical Models, Analysis and Simulation Part 1</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EK2350</td>
<td>Microsystem Technology</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2420</td>
<td>Automatic Control, Project Course</td>
<td>12.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2620</td>
<td>Nonlinear Control</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EN2300</td>
<td>Speech Signal Processing</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>Course code</td>
<td>Course name</td>
<td>Credits</td>
<td>Edu. level</td>
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<tr>
<td>EQ2300</td>
<td>Digital Signal Processing</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2310</td>
<td>Digital Communications</td>
<td>9.0</td>
<td>Second cycle</td>
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<tr>
<td>EQ2400</td>
<td>Adaptive Signal Processing</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2430</td>
<td>Project Course in Signal Processing and Digital Communication</td>
<td>12.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IL2206</td>
<td>Embedded Systems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IL2212</td>
<td>Embedded Software</td>
<td>7.5</td>
<td>Second cycle</td>
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**Conditionally elective courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS2304</td>
<td>Technical English, Advanced Level</td>
<td>9.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2450</td>
<td>Hybrid and Embedded Control Systems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td><em>This or EL2450 mandatory</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EL2520</td>
<td>Control Theory and Practice, Advanced Course</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td><em>This or EL2450 mandatory</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II2204</td>
<td>Global Entrepreneurial Leadership</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME1000</td>
<td>Industrial Management</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

**Supplementary information**

Select one of EL2520, EL2450 to be counted towards your degree.

**Accelerated Program Elective Courses**

EQ2800 Optimal filtering

EQ2820 Matrix Algebra

S53849 Convex Optimization

EQ2810 Estimation theory

IK2503 Statistical Methods in Simulation

EL3200 System Identification

EL3100 Multivariable feedback control
Year 2

Mandatory courses (22.5 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2036</td>
<td>Theory and Methodology of Science with Applications (Natural and</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
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<td></td>
<td>Technological Science)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DD2426</td>
<td>Robotics and Autonomous Systems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EH2720</td>
<td>Management of Projects</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

At most one of ME1000, DS2304 and II2204 can be counted towards your degree.

Optional courses for both first and second year:

DD2380 Artificial intelligence

DN2266 Mathematical Models, Analysis and Simulation Part 1

EQ2310 Digital communications

EL2620 Nonlinear control

EQ2300 Digital signal processing

EQ2400 Adaptive signal processing

DN2290 Advanced numerical analysis

EL2420 Automatic control, project course

EQ2430 Project Course in Signal Processing and Digital Communication

ME1000 Industrial management

DS2304 Technical english, advanced level

II2204 Global Entrepreneurial Leadership

DD2447 Statistical Methods in Applied Computer Science

DD2431 Machine Learning

IL2206 Embedded systems

EN2300 Speech signal processing

EL2520 Control Theory and Practice, Advanced Course

EQ2800 Optimal filtering

EQ2810 Estimation theory

EQ2820 Matrix algebra
EL3200 System Identification

EL3100 Multivariable feedback control
Appendix 2: Specialisations

Master's Programme, Systems, Control and Robotics, 120 credits (TSCRM), Programme syllabus for studies starting in autumn 2009

This programme has no specialisations.