Programme syllabus

Master's Programme, Wireless Systems, 120 credits
Masterprogram, trådlösa system
120.0 credits

Valid for students admitted to the education from autumn 16 (HT - Autumn term; VT - Spring term).

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

Programme objectives

The Master's Programme in Wireless Systems is a course based program focused on enabling technologies for wireless systems. It provides a broad curriculum composed of courses on communication theory, radio communication, signal processing, multimedia processing and communication networks.

Knowledge and understanding

For the master’s degree, the student should:

- show knowledge and understanding about key technologies for wireless systems, including an overview of the area as well as a deeper knowledge within communications theory, signal processing, radio communication and communication networks and insight in the ongoing research and development work
- Show deepened knowledge about methods within the area.

Skills and abilities

For the master’s degree, the student should:

- show the ability to integrate knowledge and analyse, judge and handle complex phenomena, inquiries and situations, even with limited information
- show the ability to independently identify and formulate inquiries and to plan, and with adequate methods, carry out qualified analysis and design of communication systems, within given time constraints
- show the ability to orally, and in writing, clearly present and discuss one’s own conclusions and the knowledge and arguments which are the foundation for them in a dialogue with different groups
- show such a skill which is demanded in order to participate in research and development work within the area
Ability to make judgements and adopt a standpoint

For the master’s degree, the student should:

- 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.

Extent and content of the programme

The programme is on the second level and comprises 120 higher education credits (equivalent to 120 ECTS) corresponding to two years of full-time studies. The language of instruction throughout the programme is English. The following specialisations are offered:

- Information Transmission and Processing
- Wireless Networks.
- Multimedia Signal Processing

Eligibility and selection

Basic eligibility

Basic eligibility to be accepted to the master’s programme requires that the applicant has a degree on the first level consisting of at least 180 higher education credits or a corresponding foreign degree.

Specific eligibility

- Previous education must include at least 6 months of studies (corresponding 30 higher education credits) within electrical engineering, electronics, or computer science.
- Previous education must also include basic mathematics courses within linear algebra, Fourier methods and probability theory
- The student must have taken (with passing grades) a course about signals and systems, including material about time-continuous and time-discrete systems, sampling, linear filters and systems, and transform methods (Fourier, Laplace and Z).
- A good knowledge of English, equivalent to Eng 6.

The specific eligibility requirements can be assessed as not-fulfilled if the average grade is less than 75% of the highest average grade.

Selection
The number of places in the masters program is limited. The selection process is based on the following selection criteria: University, previous studies (for instance GPA, grades in specific subjects and English), motivation for the studies (for instance letter of motivation, references, thesis proposal and relevant work experience). The evaluation scale is 1-75.

**Implementation of the education**

**Structure of the education**

The study year for KTH's undergraduate education is divided into two semesters, each with two study periods (four study periods in total over the year). Each study period is followed by an exam period. For detailed information about the academic year please see the KTH student web.

The programme comprises 2 years of full-time studies (120 higher education credits) including a half-year degree project (30 higher education credits). The programme includes 47-50 higher education credits of compulsory courses and, furthermore 12-15 higher education credits of conditionally elective courses depending on the students choice of specialisation.

**Courses**

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

Beyond the course list, the student can, after assessment, be granted to study other courses which are offered within the Master of Science in Electrical Engineering programme.

**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.

The grades pass (P) and fail (F) are also used for the degree project.

Since the grading systems differ between different countries, the grades from studies abroad will not be transferred to the KTH grading system.

**Conditions for participation in the programme**

**Registration for the term**

All students accepted to a programme must register for each term they intend to actively pursue studies. For newly admitted students this is done in connection with the compulsory registration meeting at beginning of term. For all following terms of the program, the student enters the registration for the term via their Personal Menu at www.kth.se. The registration is possible during a limited time period. This registration is necessary for reporting of results and required so that student's stipend (studiemedel) can be disbursed by CSN.

**Course Selection**
The selection of courses for the coming term must be done by the student via the www.antagning.se with the students KTH-account:

- May 1-15th for the fall term
- November 1-15th for the spring term

**Course registration**

Each student must before every study period register for all courses they are admitted to. The course registration is either done via the Personal Menu at www.kth.se or according to instructions from the course coordinator or the department giving the course. If the student decides not to take a course, then the student should notify the course administrator.

**Conditions for being promoted to the next level**

For promotion to study year two, the student must have received at least 45 higher education credits from the first year. In order to receive the degree, the student must fulfil the criteria for at least one of the specializations.

**Recognition of previous academic studies**

According to the Swedish Higher Education Ordinance, a student who has gone through certain first-cycle study courses and study programmes with a passing result has the right to have such credit recognised for a corresponding course of education at another institution of higher education. The Director of Undergraduate Studies (Grundutbildningsansvarig) at the School of Electrical Engineering will make the decisions concerning recognition of entire courses. Awards of credits for parts of courses may be decided upon by an examiner.

For further information on recognition of previous academic studies, see the KTH:s regelverk.

**Studies abroad**

Exchange studies are available through a number of agreements between KTH and other universities. The Degree project (Master’s Thesis project) can be performed abroad providing the student has an advisor and examiner at KTH and an advisor at the receiving institution or company, and that the work follows the KTH regulations for a degree projects.

**Degree project**

General rules and guidelines for the thesis and grading of the thesis are described in the KTH regulations. The degree project comprises 30 higher education credits corresponding to 20 weeks of full time studies. In order to start the degree project, the student must have passed at least 60 higher education credits of completed courses at least 30 higher education credits should be in depth studies on the second cycle level within the area of technology for which the degree is being prepared.
The degree project should be performed within the area of technology for which the degree is being prepared. The degree project is carried out individually and must be within an area corresponding to the courses which the student has taken. Before the degree project is started, it must be approved both by the KTH examiner and the program director.

The degree project is graded according to the P-F scale, using the three bases for assessment common to all grading at KTH: the engineering and scientific content, the process, and the presentation.

Degree

Students who have successfully completed a two-year Master's programme (120 ECTS) can apply for a "Teknologie masterexamen", translated into English as "Degree of Master of Science (two years)".

To be able to apply for the degree the student has to fulfill the national qualification requirements and have completed courses corresponding to 120 higher education credits including:

- At least 90 higher education credits from the course list
- All compulsory courses
- at least two out of the three conditionally elective courses for at least one of the specializations
- Between 6 and 15 higher education credits from the list of non-technical (TMS) courses
- Passed Degree Project 30 higher education credits

The student applies for their degree via the "Personal Menu" at www.kth.se.

KTH's local degree ordinance is available in their entirety in the KTH regulatory framework that can be found on the intranet. The main subject for the degree will be stated in the degree certificate.

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

Master's Programme, Wireless Systems, 120 credits (TTLSM), Programme syllabus for studies starting in autumn 2016

## General courses

### Year 1

#### Mandatory courses (51.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ1220</td>
<td><strong>Signal Theory</strong> Only for students who haven't read EQ1240 of EQ1260</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>EQ2220</td>
<td><strong>The Sustainable Wireless Systems Engineer</strong></td>
<td>3.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2310</td>
<td><strong>Digital Communications</strong></td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2440</td>
<td><strong>Project in Wireless Communication</strong> Only mandatory for track - Information Processing and Transmission</td>
<td>12.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2442</td>
<td><strong>Project Course on Multimedia Signal Processing</strong></td>
<td>12.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2507</td>
<td><strong>Wireless Communication Systems</strong></td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

#### 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>EP2200</td>
<td><strong>Queuing Theory and Teletraffic Systems</strong> Only conditionally elective for track - Wireless Communications and Networks</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2300</td>
<td><strong>Digital Signal Processing</strong> Conditionally elective for track - Information Processing and Transmission, Wireless Communications and Networks, Wireless Multimedia</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2320</td>
<td><strong>Speech Signal Processing</strong> Only conditionally elective for track - Wireless Multimedia</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td><strong>Image and Video Processing</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EQ2330  Only conditionally elective for track - Wireless Multimedia  Adaptive Signal Processing  7.5 hp  Second cycle
EQ2400  Only conditionally elective for track - Information Processing and Transmission  Advanced Digital Communications  6.0 hp  Second cycle
EQ2410  Only conditionally elective for track - Information Processing and Transmission, Wireless Communications and Networks  6.0 hp  Second cycle

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK1213</td>
<td>Swedish Society, Culture and Industry in Historical Perspective</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>DD2448</td>
<td>Foundations of Cryptography</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EH2030</td>
<td>Business Development and Quality Management</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EH2720</td>
<td>Management of Projects</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EI2400</td>
<td>Applied Antenna Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2745</td>
<td>Principles of Wireless Sensor Networks</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EP2120</td>
<td>Internetworking</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EP2300</td>
<td>Management of Networks and Networked Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EP2500</td>
<td>Networked Systems Security</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2340</td>
<td>Pattern Recognition</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2460</td>
<td>Seminars in Wireless Systems</td>
<td>3.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2800</td>
<td>Optimal Filtering</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2831</td>
<td>Foundations in Digital Communications</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2840</td>
<td>Information Theory and Channel Coding, Accelerated Program</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2845</td>
<td>Information Theory and Source Coding</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EQ2870</td>
<td>Machine to machine communication</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2555</td>
<td>Wireless and Mobile Network Architectures</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IL2219</td>
<td>Radio Electronics</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IT2651</td>
<td>Microwave Engineering</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>LS140N</td>
<td>Swedish A1 for Engineers</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>LS1419</td>
<td>English for Employment</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>LS1465</td>
<td>Rhetoric - Speaking and Writing for Impact</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>LS1502</td>
<td>Swedish A1 for Engineers</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>LS2429</td>
<td>Technical Communication in English</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>LS2439</td>
<td>English for Writing and Presenting a Degree Project in Science and Engineering</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME1003</td>
<td>Industrial Management, Basic Course</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>ME2072</td>
<td>Entrepreneurship for Engineers</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME2089</td>
<td>Leadership in Cross-Cultural and Industrial Contexts</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Programme syllabus for Master's Programme, Wireless Systems, 120 credits batch autumn 16.  Appendix 1, page 2 of 5
Supplementary information

Course list: Information is based upon the curriculum for academic year 2015/2016. Changes may occur.

Track - Information Processing and Transmission:

- **Mandatory course** EQ2440 Project in Wireless Communication
- **Conditionally elective courses** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EQ2400 Adaptive Signal Processing, EQ2410 Advanced Digital Communications

Track - Wireless Communications and Networks:

- **Mandatory courses:** IK2510 Wireless Networks, IK2511 Mobile Network Project
- **Conditionally elective courses:** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EP2200 Queuing Theory and Teletraffic Systems, EQ2410 Advanced Digital Communications

Track - Wireless Multimedia:

- **Mandatory course:** EN2600 Project Course on Multimedia Signal Processing
- **Conditionally elective courses:** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EN2300 Speech Signal Processing, EN2401 Image- och Video Processing

Year 2

Mandatory courses (25.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2036</td>
<td>Theory and Methodology of Science with Applications (Natural and Technological Science)</td>
<td>7.5 hp  Second cycle</td>
</tr>
<tr>
<td>EQ2220</td>
<td>The Sustainable Wireless Systems Engineer</td>
<td>3.0 hp  Second cycle</td>
</tr>
<tr>
<td>IK2510</td>
<td>Only mandatory for track - Wireless Communications and Networks</td>
<td>7.5 hp  Second cycle</td>
</tr>
<tr>
<td>IK2511</td>
<td>Only mandatory for track - Wireless Communications and Networks</td>
<td>7.5 hp  Second cycle</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK1213</td>
<td>Swedish Society, Culture and Industry in Historical Perspective</td>
<td>7.5 hp  First cycle</td>
</tr>
<tr>
<td>DD2448</td>
<td>Foundations of Cryptography</td>
<td>7.5 hp  Second cycle</td>
</tr>
</tbody>
</table>
EH2030  Business Development and Quality Management  7.5 hp  Second cycle
EH2720  Management of Projects  7.5 hp  Second cycle
EI2400  Applied Antenna Theory  7.5 hp  Second cycle
EI2420  Electromagnetic Wave Propagation  7.5 hp  Second cycle
EL2745  Principles of Wireless Sensor Networks  7.5 hp  Second cycle
EP2120  Internetworking  7.5 hp  Second cycle
EP2200  Queuing Theory and Teletraffic Systems  7.5 hp  Second cycle
EP2210  Performance Analysis of Communication Networks  7.5 hp  Second cycle
EP2300  Management of Networks and Networked Systems  7.5 hp  Second cycle
EP2500  Networked Systems Security  7.5 hp  Second cycle
EQ2321  Speech and Audio Processing  7.5 hp  Second cycle
EQ2330  Image and Video Processing  7.5 hp  Second cycle
EQ2340  Pattern Recognition  7.5 hp  Second cycle
EQ2401  Adaptive Signal Processing  7.5 hp  Second cycle
EQ2411  Advanced Digital Communications  7.5 hp  Second cycle
EQ2810  Estimation Theory, Accelerated Program Course  6.0 hp  Second cycle
EQ2820  Matrix Algebra, Accelerated Program  7.5 hp  Second cycle
EQ2845  Information Theory and Source Coding  7.5 hp  Second cycle
EQ2850  Coding for Wireless Communications, Accelerated Program  7.5 hp  Second cycle
EQ2871  Cyber-Physical Networking  7.5 hp  Second cycle
IK2514  Wireless Infrastructure Deployment & Economics  7.5 hp  Second cycle
IK2560  Mobile Networks and Services  7.5 hp  Second cycle
IL2219  Radio Electronics  7.5 hp  Second cycle
LS140N  Swedish A1 for Engineers  7.5 hp  First cycle
LS1419  English for Employment  7.5 hp  First cycle
LS1465  Rhetoric - Speaking and Writing for Impact  7.5 hp  First cycle
LS1502  Swedish A1 for Engineers  7.5 hp  First cycle
LS2429  Technical Communication in English  7.5 hp  Second cycle
LS2439  English for Writing and Presenting a Degree Project in Science and Engineering  7.5 hp  Second cycle
ME1003  Industrial Management, Basic Course  6.0 hp  First cycle
ME2072  Entrepreneurship for Engineers  6.0 hp  Second cycle
ME2089  Leadership in Cross-Cultural and Industrial Contexts  6.0 hp  Second cycle
SK2814  Microwave Engineering  7.5 hp  Second cycle

Supplementary information

Course list: Information is based upon the curriculum for academic year 2015/2016. Changes may occur.

Track - Information Processing and Transmission:

• **Mandatory course** EQ2440 Project in Wireless Communication
• **Conditionally elective courses** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EQ2401 Adaptive Signal Processing, EQ2411 Advanced Digital Communications

**Track - Wireless Communications and Networks:**

- **Mandatory courses:** IK2510 Wireless Networks, IK2511 Mobile Network Project
- **Conditionally elective courses:** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EP2200 Queuing Theory and Teletraffic Systems, EQ2411 Advanced Digital Communications

**Track - Wireless Multimedia:**

- **Mandatory course:** EQ2442 Project Course on Multimedia Signal Processing
- **Conditionally elective courses:** Select at least two of the following tree courses: EQ2300 Digital Signal Processing, EQ2320 Speech Signal Processing, EQ2330 Image- och Video Processing
Appendix 2: Specialisations

Master's Programme, Wireless Systems, 120 credits (TTLSM), Programme syllabus for studies starting in autumn 2016

This programme has no specialisations.