Programme objectives

The overall goal of the programme is to graduate qualified students with the ability to apply mathematical and computer-based methods for solving problems in the area of communication systems, with focus on design, implementation, and analysis of communication systems.

The programme is designed so that students, when they graduate, can carry out independent work such as development work within the area. The student should also have developed a critical reflection attitude for scientific knowledge as well as dependable experience within the area of communication systems. The programme will also give a solid basis for graduate (PhD) education within the area.

Knowledge and understanding

For the degree of Master of Science the student should:

- Show knowledge and understanding within information and communication technology with specialization in communication systems, including broad knowledge of the area as well as the essential in-depth knowledge within certain parts of the area together with in-depth knowledge of the current research and development activities.
- Show in-depth knowledge within information and communication technology.
- Show in-depth knowledge and understanding for the scientific principles within information and communication technology with specialization in communication systems.
- Identify and describe examples of sustainability aspects related to communication systems.
- Give examples of and explain social, ethical and environmental aspects of sustainable development in the area of communication systems.

Skills and abilities

For the degree of Master of Science the student should:
• Show ability to critically and systematically integrate knowledge and to analyze, estimate and handle complex phenomena, problems and situations even with limited input.
• Show ability to critically, independently and creatively identify and formulate problems, to plan and with adequate methods carry out demanding tasks within given time frames and that way contribute to science development and evaluate that work.
• Show ability to, nationally as well as internationally, clearly account for and discuss his conclusions and the scientific arguments behind that in dialogues with different groups.
• Show such proficiency that is needed to participate in research and development or to independently work in other qualified activity.
• Show ability to follow the technical development in communication systems.
• Show ability to use fundamental knowledge in order to investigate new and interesting ideas.
• Based on various definitions of sustainable development illustrate and point out perspectives where progress within communication systems can be relevant for sustainable development in society.

Ability to make judgements and adopt a standpoint

For the degree of Master of Science the student should:

• Show ability to, within communication systems, make assessments with respect to relevant scientific, social and ethical aspects and also show awareness about ethical aspects on research and development.
• Show ability to compare and evaluate possibilities and limitations of communication technology in the society and how communication technology is used from a sustainability perspective.
• Show insight on the possibilities and limitations of science, his/her role in the society and people's responsibility for how it can be used.
• Show ability to identify his/her needs of further knowledge and to have the responsibility for his/her development.

Extent and content of the programme

The Communication Systems program is a two year master program. It consists of 1.5 year (90 ECTS credits) of course work and half a year (30 ECTS credits) of Master thesis project work. The program starts with a set of compulsory courses (30 ECTS credits) which provide broad and in-depth knowledge in the fundamental areas of Communication Systems. The program continues with specialization tracks including some mandatory courses within the track and a wide range of elective courses, allowing the student to specialize within the programme subject areas. The third semester includes a project-oriented course (compulsory) that gives the student the possibility to work in groups and within research projects that run within the School of Information and Communication Technology. The fourth semester is devoted to the Master thesis project work.

The courses in the programme can be grouped into four main subject areas:

• Internetworking
• Wireless Networks
• ICT Entrepreneurship and Product Realization
• Communication Systems Security

The following specialization tracks are offered:
Internetworking
Wireless Networking

Eligibility and selection

A completed Bachelor’s degree, equivalent to a Swedish Bachelor’s degree (180 ECTS credits), from a university recognized by government or accredited by other recognized organization. A Bachelor’s degree in Science or Engineering is required for most programs.

To qualify for the Communication Systems Master program, the student should have a Bachelor of Science degree in Electrical/Electronic Engineering, Computer Science, Computer Engineering, Computer Science, or Information Technology, including at least 60 ECTS credits (hp) courses in computer science, basic data/telecom and internetworking, computer systems (computer architecture and operating systems) and programming, at least 30 ECTS credits course work in mathematics, including calculus, linear algebra and mathematical statistics.

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.

The specific requirements may be assessed as not fulfilled if

1. The average grade is in the lower third on the grading scale used (above pass level).
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.

A good knowledge of written and spoken English:

Applicants must provide proof of their proficiency in English. The Royal Institute of Technology (KTH) accepts a:

- TOEFL paper based test, total of 575, 4.5 writing section
- TOEFL internet based test, total of 90, 20 writing section
- IELTS score of at least 6.5, no band lower than 5.5 (only academic training accepted)

English proficiency tests are waived for applicants with English as language of instruction (minimum 3 years of full-time higher education studies). The student should provide relevant certificate from his/her university with the application.

Knowledge of English may be taken into account in the selection process, i.e. a good TOEFL/IELTS result may be of added value.

For selection please see KTH local regulations for degrees.

Implementation of the education
Structure of the education

The school year for KTH undergraduate education is divided into four periods. The study periods have about 7 weeks each with a minimum of 33 study days. Each study period is followed by an exam period containing two available days and at least five exam days. In addition to the four ordinary exam periods three re-exam periods are provided; in January, after May and directly before the first period of the school year.

The school year includes 40 weeks. Teaching, if necessary, can take place outside the school year.

The first year consists of four compulsory courses, two mandatory courses within each specialization track and two elective courses. The second year consists of specialization courses. The education finishes with the Master thesis project.

Courses

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

The curriculum is implemented as a 120 credits (hp) masters program:

- Compulsory courses: 30 ECTS credits (hp)
- Mandatory courses within the track and elective courses, including project courses: 60 ECTS credits (hp)
- Masters thesis work: 30 ECTS credits (hp)

For details see the course list in the appendix.

Further elective courses from KTH or other national/international universities may be included, but requires approval from the programme director.

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.

Conditions for participation in the programme

Semester registration

All students following an education programme at KTH must register for each semester with the exception of the first semester for which registration is performed automatically. Registration per semester is performed by the student through the personal menu at www.kth.se. Semester registration is necessary for enabling the registration of results from the studies and is a pre-requisite for granted student finance payment (CSN medel).

Course Selection
No application is needed for the compulsory courses in year 1 and 2. Course selection takes place in two election periods every school year. Election before the Fall at the latest May 15 and before the Spring at the latest November 15.

**Study Authorization (Studieberättigande)**

Requirements for studies in year two:

At least 40 ECTS points out of year one should have been completed by the August period.

Students that do not accumulate the required number of points by the August period will not be transferred to the next semester, instead they will be re-registered for the same study period as before. An individual study plans needs to be approved before new courses can be taken.

**Recognition of previous academic studies**

According to the high school regulation (högskoleförordningen) a student, that went through higher education with approved result, has the right to count that for a corresponding education in other University. The same applies to students that went through higher education with approved results in Denmark, Finland, Island or Norway or in any other European country that took part in the convention of the European council of April 11 1997 on the recognition of qualifications concerning higher education in the European Union.

**Studies abroad**

Studies abroad are encouraged. The conditions for such studies is made in consultation with the programme director and the international coordinator.

Contact the international coordinator at the School of Information and Communication Technology for more information.

**Degree project**

To be awarded a Master’s degree in Communication Systems the student must, within the course requirements, have fulfilled an independent work (the master’s thesis project) of at least 30 credits in Communication Systems.

The subject for the thesis project may be chosen by the student to be performed at KTH, at other universities, or in industry. A student who has been promoted to the second year, and has completed at least 60 ECTS credits may apply to start a thesis project.

The degree project is graded P/F (Pass/Fail). In order to pass, the degree project must show high quality as tested against the relevant examination objectives, often all national examination objectives. Directives and criteria for passing and grading are available at:

Specific directives and criteria for grading is available in the official course syllabus.

Degree

The Master’s degree is obtained after completion of the courses and the thesis with a total of at least 120 credits. The degree is "Teknologie masterexamen", translated into English as "Degree of Master of Science (two years)". The degree is awarded after application from the student. Application for degree is made via the personal menu at www.kth.se.

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

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

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>ID2212</td>
<td>Network Programming with Java</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>II2202</td>
<td>Research Methodology and Scientific Writing</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2206</td>
<td>Internet Security and Privacy</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2215</td>
<td>Advanced Internetworking</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>ID2216</td>
<td>Developing Mobile Applications</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ID2218</td>
<td>Design of Fault-tolerant Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK1611</td>
<td>Dimensioning of Communication Systems</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>IK2220</td>
<td>Software Defined Networking (SDN) and Network Functions Virtualization (NFV)</td>
<td>7.5 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>IO2654</td>
<td>Optical Networking</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME2062</td>
<td>Technology-based Entrepreneurship</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Year 2

Mandatory courses (15.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
</table>
IK2200  Communication System Design  15.0 hp  Second cycle

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>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>EP2510</td>
<td>Advanced Networked Systems Security</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>II2300</td>
<td>Product Realization Processes I</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>II2302</td>
<td>Sensor Based Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2510</td>
<td>Wireless Networks</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2511</td>
<td>Project in Wireless Networks</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2514</td>
<td>Wireless Infrastructure Deployment &amp; Economics</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2554</td>
<td>Practical Voice Over IP (VoIP)</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IS2500</td>
<td>RFID Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

Degree project 30 credits on advanced level is mandatory during the spring term.

Track, Internetworking (ITE)

Year 1

Mandatory courses (15.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IK2213</td>
<td>Network Services and Internet-based Applications</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2217</td>
<td>Advanced Internetworking II</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

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>IK2507</td>
<td>Wireless Communication Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2508</td>
<td>Wireless Transmission Techniques</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Track, Wireless networking (TRN)

Year 1
### Mandatory courses (15.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IK2507</td>
<td>Wireless Communication Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2508</td>
<td>Wireless Transmission Techniques</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

### Optional courses

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>IK2213</td>
<td>Network Services and Internet-based Applications</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IK2217</td>
<td>Advanced Internetworking II</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
Appendix 2: Specialisations

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

Track, Internetworking (ITE)

Track, Wireless networking (TRN)