Programme syllabus

Master's Programme, Medical Imaging, 120 credits
Masterprogram, medicinsk bildbehandling
120.0 credits

Valid for students admitted to the education from autumn 10 (HT - Autumn term; VT - Spring term).

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

Programme objectives

Beyond the objectives which are specified in the Higher Education Degree Ordinance, there are also specific goals for this programme. After completing the programme, the student should:

Knowledge and understanding

• Have a broad knowledge about anatomy, physiology and medical terminology

• Have a broad view of the field of medical engineering as well as a deep insight in the field of medical imaging

• Have a deep knowledge about the different techniques used for creating, processing and reconstructing medical images such that he/she will be able to work within the field at hospitals or the industry within research/development as well as in production and manufacturing

Skills and abilities

• Be able to identify, formulate, analyse and solve problems with regards to current circumstances (scientific, engineer-related, and social) based on ethical and professional standpoints.

• Be able to use modern tools, both hardware and computer based, for creating and processing medical images.

• Have a good ability to utilize modern modelling and simulation methods and their applications

• Have skills in presentation and communication such that good prerequisites for efficient work are achieved individually as well as in a multinational group.

Ability to make judgements and adopt a standpoint
• Show a professional and ethical responsibility in scientific, technical, ecological and social activities.

• Have understanding that engineering-related problems, considered from a system perspective are often complex, can be incompletely defined and sometimes contain conflicting conditions. Reference to the local degree ordinance of the Royal Institute of Technology (The KTH-Handbook).

**Extent and content of the programme**

The programme consists of 120 higher education credits which correspond to two years full time studies. The programme is mainly on the second level. The language of instruction for the programme is English.

**Eligibility and selection**

In order to be eligible to apply to the master’s programme, a higher education degree of at least 180 higher education credits, technical bachelor’s degree, or another corresponding technical or natural scientific degree in the first level within Engineering Physics, Electrical Engineering, Computer Science, Mathematics or equivalent must be completed. The degree must contain courses in Mathematics, Computing, Physics and Electronics equivalent to at least 45 higher education credits. Other studies or work experiences are judged on the basis of the actual competencies which are referred to. A good knowledge of English, equivalent to Eng. B

**Specific admission requirements**

The specific requirements may be assessed as not fulfilled if

1. the degree awarding institution is not considered to meet acceptable quality standards by the authorities of the country in which the institution is located
2. the degree does not qualify for admission to equivalent Master level in the country where the degree is awarded

**Selection** The selection to the programme is based on the evaluation of the following criteria: university /higher education institute, courses relevant to the programme, suggestion to the degree project, recommendation letters and references. The reference to KTH’s admission policy can be found in the KTH-Handbook.

**Implementation of the education**

**Structure of the education**

In the first semester basic courses in anatomy, physiology and medical engineering are given together with mainly theoretical courses in the mathematical methods and physics of microscopy and imaging.

In the second and third semester the students choose their specialization. They can either focus on *clinical imaging* or *biophysical imaging*.

For the students who choose to focus on clinical imaging there are separate courses in all the modalities of medical imaging (ultrasound, X-ray, MRI). There is also an introductory course in medical simulation
methods and a course in radiation therapy. During the third semester there is a course in safe medical devices, so that the students should gain knowledge about all the rules and regulations that is associated with medical engineering.

For those who focus on biophysical imaging there are courses in the different techniques used there, like electrodynamics, X-ray crystallography and X-ray microscopy. They also get the theoretical background through courses in structural biology, cell biology and quantum mechanics.

Both groups also take a course in image reconstruction. The third semester also contains a course in entrepreneurship, in order for the students to get an early contact with the industry and get a feeling for this particular field of engineering. There is finally a course in science theory and research methodology to prepare the students for the master’s thesis and also for possible future research in the field of medical engineering.

The last term is devoted to a degree project which is carried out in a group of two or individually. The degree project can be carried out at an industrial company, a hospital or at an institution. Study year, term, and study period descriptions can be found in the KTH Study Handbook.

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

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

Term Enrolment

A condition in order to be able to participate in the studies is that the student must enrol for the next term every spring and fall. This is done via “Mina Sidor” on KTH’s website between November 1st and 15th and between May 1st and 15th. With the enrolment, the student has submitted their intention of studying and participating in the programme. Only after that is it possible for the student to:

- register for courses
- register for the term
- get results

For studies in study year 2: At least 45 higher education credits from study year 1 must be completed by the exam period in August. Students which have not fulfilled this requirement must consult with the study counsellor and set up an individual study plan. The main goal with the study plan is that the student should complete the remaining elements during the next study year. In the study plan, the remaining elements and also suitable courses from the next study year are included. Special regard should be taken to the courses prerequisites.
Recognition of previous academic studies

The student has the possibility to apply to receive credit from courses taken at another university/higher education institution both in Sweden and from abroad. The application can be found on KTH’s website. KTH’s policy for recognition of previous academic studies can be found entirely in the KTH-Handbook.

Degree project

KTH’s rules for the degree project for the Master’s degree with specialisation can be found in the KTHHandbook. Generally, the degree project work can be started only after a large portion of the studies have been completed. KTH’s rules for the degree project can be found in the KTH-Handbook KTH-Handbok 2, page 15.5 www.kth.se/info/kth-handboken/II/15/5.html

Degree

In order to graduate with the Degree of Master of Science (120 cr.), a passing grade must be achieved in all courses which are in the student’s study plan. The study plan must comprise 120 higher education credits including a degree project consisting of 30 higher education credits.

Complete information on the degree requirements can be found at the local degree policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227?l=en_UK

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

Master's Programme, Medical Imaging, 120 credits (TMEEM), Programme syllabus for studies starting in autumn 2010

### General courses

#### Year 1

**Mandatory courses (36.0 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL1010</td>
<td>Systems Biology</td>
<td>7.5 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>HL2006</td>
<td>Medical Engineering, Basic Course</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2007</td>
<td>Mathematical Methods of 3D Microscopy</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2012</td>
<td>3D Image Reconstruction in Medicine</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SK2501</td>
<td>Physics of Biomedical Microscopy, Extended Course</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>HL2008</td>
<td>Simulation Methods in Medical Engineering Clinical Imaging</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2009</td>
<td>Ionising Radiation Imaging Clinical Imaging</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2010</td>
<td>Ultrasound Clinical Imaging</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2011</td>
<td>Magnetic Resonance Imaging Clinical Imaging</td>
<td>4.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2022</td>
<td>Quantum Mechanics of Electron Microscopy Biophysical Imaging</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2023</td>
<td>Electro Dynamics and Waves Biophysical Imaging</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>HL2025</td>
<td>Structural Biology and Cell Biology Biophysical Imaging</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
Supplementary information

There are two specializations within the programme:

In the focus area *Clinical Imaging* a thorough overview of state-of-the-art detectors in Medical Imaging as well as the latest developments in integrated electronics and computing in this field will be studied.

In the focus area *Biophysical Imaging* you will learn about modern techniques for studying biological structures from cells to macro-molecules. Light- electron- and X-ray microscopy as well as electron- and X-ray crystallography will be covered in both theory and practice. Additionally the mathematical and physical basis of these methods will be discussed.

The students choose specialization after the 1st semester and the course list will differ in semester 2 and 3.

**Year 2**

**Mandatory courses (15.0 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>SH2001</td>
<td>Entrepreneurship for Engineering Physicists</td>
<td>7.5 hp Second cycle</td>
</tr>
</tbody>
</table>

**Conditionally elective courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL2013</td>
<td>Radiation Therapy Clinical Imaging</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>HL2014</td>
<td>Safe Medical Devices Clinical Imaging</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>HL2024</td>
<td>X-ray Crystallography and X-ray Microscopy Biophysical Imaging</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>HL2026</td>
<td>Electron Microscopy Biophysical Imaging</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>HL202X</td>
<td>Degree Project in Medical Engineering, Second Cycle</td>
<td>30.0 hp Second cycle</td>
</tr>
<tr>
<td>HL203X</td>
<td>Degree Project in Medical Imaging, Second Cycle</td>
<td>30.0 hp Second cycle</td>
</tr>
</tbody>
</table>
Appendix 2: Specialisations

Master's Programme, Medical Imaging, 120 credits (TMEEM), Programme syllabus for studies starting in autumn 2010

This programme has no specialisations.