



# Programme syllabus

Master's Programme, Medical Engineering, 120 credits

Masterprogram, medicinsk teknik

*120.0 credits*

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*Valid for students admitted to the education from autumn 17 (HT - Autumn term; VT - Spring term).*

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

## Programme objectives

The programme corresponds to the two final years of the five year engineering program in Medical engineering at KTH and has as a goal to educate the future engineers for working at the border where technology and medicine meet.

A master from the programme in medical engineering will have the knowledge to within the field of medical engineering both analyze and solve problems as well as thinking in an innovative way.

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 have:

### Knowledge and understanding

- a deep insight in the field of medical engineering
- a broad knowledge about anatomy, physiology and medical terminology as well as an understanding of the different needs for technical solutions in the healthcare
- knowledge about scientific tools for analyzing, working on and valuing facts as well as understanding how knowledge evolves in natural science, technology and social science

### Skills and abilities

- ability to, both independently and in a group, put knowledge and abilities into practical action, with consideration to relevant scientific, professional and sociological judgments and opinions
- ability to identify, formulate, analyze and solve problems with regards to current circumstances (scientific, engineer-related, and social) based on ethical and professional standpoints
- skills in presentation and communication, especially regarding the healthcare, 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

- a professional and ethical responsibility in scientific, technical, ecological and social activities
- understanding that engineering-related problems, considered from a system perspective are often complex, can be incompletely defined and sometimes contain conflicting conditions
- a will to follow and use the development of knowledge in the field of medical engineering

## 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.

All the compulsory courses apart from the HL1007 basic course in Medical engineering, which is compulsory for some students, are on the second level, but some elective courses may be on the first level.

The language of instruction for the programme is mainly English. All compulsory courses are in English, but some elective and conditionally elective courses may be given in Swedish. It will however be possible to achieve a full degree using only courses in English.

Due to the cross-disciplinary nature of the programme the students will follow one out of five specialisations:

- Modern Physics
- Mechanics
- Electronics
- Information Technology
- Organisation and Management

Each specialisation contains compulsory and conditionally elective courses. The sum of those should correspond to at least 75 credits. All students should also do a 30 cr master's degree project. The remaining credits are elective courses, but these courses should be relevant for the objectives of the programme.

Students with a different bachelor degree than medical engineering may be eligible for the programme, but have to take two extra compulsory courses during the first semester.

## Eligibility and selection

In order to be eligible to apply to the master's programme, a bachelor's degree or corresponding degree in the first level within Engineering Physics, Electrical Engineering, Computer Science, Mathematics or equivalent of at least 180 ECTS, must be completed. The degree must contain courses in Mathematics, Physics, Computing and Electronics equivalent to at least 60 ECTS. The 60 ECTS must contain at least 25 credits in Mathematics, 15 credits in Physics, 10 credits in Computing and 5 credits in Electronics.

Other studies or work experiences are judged on the basis of the actual competencies which are referred to.

The selection to the programme is based on the evaluation of the following criteria: university/higher education institute where the bachelor degree was given, courses relevant to the programme, personal letter with motivation to the choice of programme and a suggestion for the degree project, recommendation letters and references.

## Implementation of the education

### Structure of the education

The structure of the programme makes it possible for both students who have a bachelor degree in Medical engineering and those with a more general engineering background to study at the programme.

The students who do not have a bachelor degree in medical engineering will start the first semester with one basic course in medical engineering and one in anatomy and physiology. Besides that the students in both cases will take the compulsory courses spread out over the three semesters and in parallel to that take the conditionally elective and elective courses. The compulsory courses will give the knowledge about the medical engineering applications and the conditionally elective courses will give the technical and scientific background needed.

In the third semester there is 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.

For students with a bachelor degree within another field than Medical Engineering the courses:

\* HL1007 Medical Engineering, basic course

\* HL2017 Advanced Physiology, smaller course

are compulsory.

In the specialisations the following courses are compulsory:

- **Modern Physics:**

HL2013 Radiation Therapy

HL2019 Ionising Radiation Imaging

HL2010 Ultrasound

HL2011 Magnetic Resonance Imaging

- **Mechanics:**

HL2005 Implants and Biomaterials

HL2035 Biomechanics and Neuronics

SG2804 Biomechanics of Human Movement

- **Electronics:**

HI2010 Medical Information and Communication Systems

HL2005 Implants and Biomaterials

EK2350 Microsystem Technology

- **Information Technology:**

HI2010 Medical Information and Communication Systems

DD2423 Image Analysis and Computer Vision

HL2008 Simulation Methods in Medical Engineering

HL2027 3D Image Reconstruction and Analysis in Medicine

- **Organisation and Management:**

HM102V Healthcare Logistics-theory

HN2013 Ergonomics, Human Factors and Patient Safety

HL2016 Technology in Surgery, Anaesthesia, and Intensive Care

## 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

Between 1 and 15 of May the students apply for admission to courses for the upcoming autumn term, and between 1 and 15 of november for the upcoming spring term.

The students register online for the programme every start of a term and register for courses every start of a study period.

Only after that it is possible for the student to get results reported.

In order to register for the courses the students must fulfill the specific prerequisites for that course.

Some of the elective courses may have a limitation in the number of participants. In such cases the selection will be based on first the number of credits achieved in the programme and then the grades.

For studies in study year 2 at least 45 higher education credits from study year 1 must be completed by the end of the exam period in August. Students who have not fulfilled this requirement must consult with the study counselor 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 prerequisites of the courses

## **Recognition of previous academic studies**

The student has the possibility to apply to receive credits from courses taken at another university/higher education institution both in Sweden and from abroad. The application form can be found on KTH's website.

## **Studies abroad**

After approval by the programme director, part of the studies may be carried out abroad (including the Master's degree project). The condition is that the parts of the programme carried out abroad should fit in with the educational programme.

## **Degree project**

A 30-credit Master's degree project is carried out at the end of the educational programme (usually the fourth semester). The purpose of the project is to let the student study a problem in more depth than is possible in the courses. The degree project can be carried out at an industrial company, a hospital or at an academic institution in Sweden or abroad.

## **Degree**

In order to graduate with the Degree of Master of Science (Two Years) within the main area Medical Engineering, 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.

To receive the MSc degree, students must fill in an online application form.

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



# Appendix 1: Course list

Master's Programme, Medical Engineering, 120 credits (TMLEM), Programme syllabus for studies starting in autumn 2017

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## General courses

### Year 1

#### Mandatory courses (24.0 credits)

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Course code	Course name	Credits	Edu. level
HL2010	Medical Information and Communication Systems	6.0	Second cycle
HL1007	Medical Engineering, Basic Course	6.0	First cycle
HL2016	Technology in Surgery, Anaesthesia, and Intensive Care	6.0	Second cycle
HN2013	Ergonomics, Human Factors and Patient Safety	6.0	Second cycle

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#### Conditionally elective courses

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Course code	Course name	Credits	Edu. level
DD2401	Neuroscience	7.5	Second cycle
DD2423	Image Analysis and Computer Vision	7.5	Second cycle
EK2350	Microsystem Technology	7.5	Second cycle
HL2003	Radiation Physics and Biology	6.0	Second cycle
HL2005	Implants and Biomaterials <i>Compulsory for specialisations: Mechanics and Electronics</i>	6.0	Second cycle
HL2008	Simulation Methods in Medical Engineering	7.5	Second cycle
HL2010	Ultrasound	6.0	Second cycle
HL2011	Magnetic Resonance Imaging	4.5	Second cycle
HL2013	Radiation Therapy	7.5	Second cycle
HL2014	Safe Medical Devices	7.5	Second cycle
HL2017	Advanced Physiology, Smaller Course	6.0	Second cycle
HL2018	Advanced Physiology	9.0	Second cycle
HL2019	Ionising Radiation Imaging	6.0	Second cycle

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<b>Course code</b>	<b>Course name</b>	<b>Credits</b>	<b>Edu. level</b>
HL2025	Structural Biology and Cell Biology	9.0	Second cycle
HL2027	3D Image Reconstruction and Analysis in Medicine	9.0	Second cycle
HL2034	Clinical Innovation and Design	9.0	Second cycle
HL2035	Biomechanics and Neuronics	7.5	Second cycle
HL2040	Physiology in Extreme Environments	7.5	Second cycle
SE2121	Introduction to Biomechanics	9.0	Second cycle
SG2804	Biomechanics of Human Movement	7.0	Second cycle
SK2501	Physics of Biomedical Microscopy, Extended Course	7.5	Second cycle
SK2510	Cellular Biophysics I	8.0	Second cycle
SK2511	Cellular Biophysics II	6.0	Second cycle
SK2520	Experimental Methods in Molecular Biophysics	8.0	Second cycle

## Year 2

### Mandatory courses (31.5 credits)

<b>Course code</b>	<b>Course name</b>	<b>Credits</b>	<b>Edu. level</b>
AK2036	Theory and Methodology of Science with Applications (Natural and Technological Science)	7.5	Second cycle
AK2050	Theory and Methodology of Science with Applications (Medical Ethics) <i>For students who has passed BB1010 Introduction to Biotechnology</i>	6.0	Second cycle
HI2010	Medical Information and Communication Systems <i>Compulsory for track Information Technology</i>	6.0	Second cycle
HL2017	Advanced Physiology, Smaller Course	6.0	Second cycle
HN2013	Ergonomics, Human Factors and Patient Safety	6.0	Second cycle

### Conditionally elective courses

<b>Course code</b>	<b>Course name</b>	<b>Credits</b>	<b>Edu. level</b>
DD2404	Applied Bioinformatics <i>Track: Information Technology</i>	7.5	Second cycle
DD2423	Image Analysis and Computer Vision <i>Compulsory for track Information Technology</i>	7.5	Second cycle
DD2425	Robotics and Autonomous Systems <i>Tracks Electronics and Information Technology</i>	9.0	Second cycle

<b>Course code</b>	<b>Course name</b>	<b>Credits</b>	<b>Edu. level</b>
DD2435	Mathematical Modelling of Biological Systems <i>Track: Information Technology</i>	9.0	Second cycle
EQ2415	Machine Learning and Data Science <i>Tracks Electronics and Information Technology</i>	7.5	Second cycle
HL2003	Radiation Physics and Biology	6.0	Second cycle
HL2005	Implants and Biomaterials <i>Compulsory for track Electronics</i>	6.0	Second cycle
HL2013	Radiation Therapy <i>Compulsory for track Modern Physics</i>	7.5	Second cycle
HL2014	Safe Medical Devices <i>Compulsory for track Organization &amp; Management</i>	7.5	Second cycle
HL2018	Advanced Physiology	9.0	Second cycle
HL2032	Medical Engineering, Project Course <i>Compulsory for track Electronics</i>	9.0	Second cycle
HL2034	Clinical Innovation and Design	9.0	Second cycle
HL2035	Biomechanics and Neuronic <i>Compulsory for track Mechanics</i>	7.5	Second cycle
HL2040	Physiology in Extreme Environments	7.5	Second cycle
HL2041	Sports Technology	9.0	Second cycle
HL205X	Degree Project in Medical Engineering, Second Cycle	30.0	Second cycle
HL207X	Degree Project in Technology and Health, Second Cycle	30.0	Second cycle
HM102V	Healthcare Logistics-theory <i>Compulsory for track Organization &amp; Management</i>	7.5	First cycle
ID2222	Data Mining <i>Track: Information Technology</i>	7.5	Second cycle
ID2223	Scalable Machine Learning and Deep Learning <i>Track: Information Technology</i>	7.5	Second cycle
ME2016	Project Management: Leadership and Control <i>Track: Organization &amp; Management</i>	6.0	Second cycle
ME2053	Logistics & Supply Chain Management <i>Track: Organization &amp; Management</i>	6.0	Second cycle
MF2030	Mechatronics basic Course <i>Tracks Electronics and Mechanics</i>	6.0	Second cycle
MF2043	Robust Mechatronics <i>Tracks Electronics and Mechanics</i>	6.0	Second cycle
SE2126	Material Mechanics <i>Track: Mechanics</i>	9.0	Second cycle
SG2804	Biomechanics of Human Movement <i>Compulsory for track Mechanics</i>	7.0	Second cycle

<b>Course code</b>	<b>Course name</b>	<b>Credits</b>	<b>Edu. level</b>
SH2103	Subatomic Physics <i>Track: Modern Physics</i>	7.5	Second cycle
SK2501	Physics of Biomedical Microscopy, Extended Course <i>Track: Modern Physics</i>	7.5	Second cycle
SK2520	Experimental Methods in Molecular Biophysics	8.0	Second cycle

### Supplementary information

The information is based on the curriculum for academic year 2017/18 and changes may occur

### Year 3





## Appendix 2: Specialisations

Master's Programme, Medical Engineering, 120 credits (TMLEM), Programme syllabus for studies starting in autumn 2017

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This programme has no specialisations.