



## Programme syllabus

Faculty of Technology

Elektroteknik, inriktning signalbehandling och vågutbredning,  
masterprogram, 120 högskolepoäng

Electrical Engineering, specialisation Signal Processing & Wave  
Propagation, Master Programme, 120 credits

### Level

Second Level

### Date of Ratification

Approved 2009-09-15

Revised 2018-12-08 by the Faculty Board within the Faculty of Technology

The programme syllabus is valid from autumn semester 2018

### Prerequisites

General entry requirements for second-cycle studies and specific entry requirements:

- Bachelor Degree in Electrical Engineering, Computer Engineering, Engineering Physics or the equivalent. All students must have completed introductory courses in Telecommunications, Electronics, Signals and Systems theory, and Mathematics including multidimensional analysis and transform theory.
- English B/6 or the equivalent

### Description of Programme

The programme allows specialization with an industrial or an academic emphasis since the number of optional courses open to the student is considerable. The first part of the programme provides a platform comprising Mathematics, Physics and Electrical Engineering. In the second year students specialize within the chosen field and complete their studies with a degree dissertation project.

The first year covers the mathematical and statistical methods that are fundamental for advanced studies at second level of telecommunication theory and antenna and microwave technology. In the first year students also meet applications in the form of radio systems.

The second year allows for specialization or alternatively the study of adjacent fields of interest.

Courses in adjacent subjects are available to a significant extent. In dissertation project work subject knowledge is transformed into scientific research writing.

### Objectives

Knowledge and understanding

For a Degree of Master (Two Years) students must

- demonstrate knowledge and understanding in their main field of study, including both broad knowledge in the field and substantially deeper knowledge of certain parts of the field, together with deeper insight into current research and development work; and
- demonstrate deeper methodological knowledge in their main field of study.

Skills and abilities

For a Degree of Master (Two Years) students must

- demonstrate an ability to critically and systematically integrate knowledge and to analyse, assess and deal with complex phenomena, issues and situations, even when limited information is available;
- demonstrate an ability to critically, independently and creatively identify and formulate issues and to plan and, using appropriate methods, carry out advanced tasks within specified time limits, so as to contribute to the development of knowledge and to evaluate this work;
- demonstrate an ability to clearly present and discuss their conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts; and
- demonstrate the skill required to participate in research and development work or to work independently in other advanced contexts.

Judgement and approach

For a Degree of Master (Two Years) students must

- demonstrate an ability to make assessments in their main field of study, taking into account relevant scientific, social and ethical aspects, and demonstrate an awareness of ethical aspects of research and development work;
- demonstrate insight into the potential and limitations of science, its role in society and people's responsibility for how it is used; and
- demonstrate an ability to identify their need of further knowledge and to take responsibility for developing their knowledge.

### **Programme specific objectives**

Knowledge and understanding

Having completed the programme the student is expected to have:

- knowledge about established research methods within signal processing and wave propagation,
- some knowledge of applied mathematics relevant to electrical engineering,
- proficiency in antenna and microwave technology,
- familiarity with signal processing applied to antenna and microwave technology,
- insight into relevant industrial problems where signal processing and wave propagation are central, for example in telecommunication,
- some knowledge of current research topics within the subject.

Skills and abilities

Having completed training the student is expected to be able to

- gather, summarise and present technical material,
- present technical and analytical solutions to given problems and to select appropriate solution strategies for new problems,
- present research within signal processing and wave propagation,
- document a technical or scientific investigation.

Content

## *Programme Overview*

Some courses are only offered every other year and are thus available either in year 1 or 2. The programme is offered by the School of Computer Science, Physics and Mathematics. The main subject area of the programme is Electrical Engineering. Most courses are optional and could be replaced by other relevant courses after consulting the programme director.

The overall responsibility for the programme lies with the programme director. The programme consists of 120 credits, or 2 years of full-time studies.

## *Programme Courses*

Year 1:

### **Multivariable Calculus and Vector Calculus**, 7,5 credits \*, (G)

A repetition and standardization of mathematics skills. The course deals with central concepts and batches in multivariate analysis and linear algebra.

### **Signal Processing**, 7.5 credits \*, (A,H)

A specialization course towards the theme of the program. The course deals with signal theory and stochastic processes with applications in adaptive and statistical signal processing.

### **Radio engineering**, 7.5 credits \*, (G,H)

A course in electrical engineering with laboratory elements. The course deals with transmission lines, resonant circuits, amplifiers, oscillators and phase locked loops.

### **Antenna technology** 7.5 credits \*, (G:H)

A specialization course towards the theme of the program. The course introduces antenna types and antenna concepts and addresses thread dipoles and group antennas.

Electives

### **Computer Graphics**, 7.5 credits, (G)

This course offers an introduction into concepts such as lighting and color models, as well as techniques and algorithms for 2D and 3D graphics.

### **Mobile Radio Communication and Wave Propagation**, 7.5 credits, (A,H)

A specialization course towards the theme of the program. Basic wave propagation, the statistical model for mobile systems, and digital modulation are dealt with.

### **Electromagnetic Field Theory**, 7.5 credits, (G,H)

A possibility of repetition and deeper knowledge of wave propagation.

### **Signal Processing Antennas**, 7.5 credits, (A,H)

Deeper knowledge of signal processing where signal theory and stochastic processes are dealt with.

### **Stochastic processes**, 7.5 credits, (G)

A review of the basic statistical concepts in signal processing.

### **Antenna theory**, 7.5 credits, (A,H)

A specialization course towards the theme of the program where antenna synthesizers and antenna types are dealt with.

**Advanced microelectronics**, 7,5 credits (A, H)

Deeper knowledge of the electronics previously studied in the course Radioteknik.

**Electric power and smart grids**, 7,5 credits (A, H)

A course that deals with high voltage technology and system aspects of the power grid.

Year 2:

**Degree project**, 30 credits (15 credits)\*, (A2E,H)

Electives

**Analytic Functions**, 7.5 credits, (G)

Fundamentals for the program's theme in the form of an introductory course in complex analysis.

**Solid State Physics**, 7.5 credits, (G)

Description of electrical, thermal and optical properties of solid materials based on crystal and electron structure.

**Microwave Theory**, 7.5 credits, (A,H)

Deeper knowledge in electrical engineering, which builds on the course Radiotechnology.

**Control Theory**, 7.5 credits, (A,H)

Deeper knowledge in electrical engineering with focus on linear variables and nonlinear systems.

**Topics in wave propagation**, 7.5 credits, (A,H)

Deeper knowledge in Wave propagation and an exercise in report writing. The course can accommodate guest lectures given by visiting teachers.

**Estimation theory**, 7.5 credits, (A,H)

Deeper knowledge into statistical signal processing where concepts such as linear estimation and Cramer-Raos lower boundary are dealt with.

**Automatic Control**, 7.5 credits (G)

An introductory course in regulatory technology where mathematical description of dynamic systems and concepts as stability is treated.

**Mathematics Project Course (Small)**, 7.5 credits (A)

A course for generic skills such as report writing.

**Partial Differential Equations**, 7.5 credits (A)

Fundamentals for the program's theme in the form of theory and applications of partial differential equations.

\* = a compulsory course

(G) = course marked with a (G) is at the elementary level

(A) = course marked with an (A) is at the advanced level (90 higher education credits required)

(H) = course marked with an (H) lies within the main subject (60 credits required)

*Societal relevance*

An advisory board is to be established in order to ensure industrial relevance and improve employment prospects.

### *Internationalization*

It is possible to study abroad on student exchanges within the framework for the programme. Exchanges are normally organized in the third term in consultation with international coordinators and the programme director.

### *Scope of programme*

The concepts of sustainability and gender are features of the public debate that permeate the university system. For a master's program with a large percentage of international students, diversity and internationalization are given features in everyday activities within the programme.

### **Quality Development**

The programme is evaluated on a yearly basis. Each course includes a course evaluation. Summaries of course and programme evaluations are archived at the school. Company contacts offer information on employment opportunities. An advisory board with external representatives is to be set up for a number of master's programmes including this programme.

### **Degree Certificate**

After completing programme studies, corresponding to the requirements expressed in the Higher Education Ordinance degree order as well as Linnaeus University degree order, the student may apply for a degree. Those who have completed the programme may obtain the following degree:

Teknologie masterexamen med inriktning mot Signalbehandling och vågutbredning  
Huvudområde: Elektroteknik

Master of Science (120 credits) with specialisation in Signal Processing and Wave Propagation.  
Main field of study: Electrical Engineering.

To obtain the prefix "Teknologie", the student should have a higher education diploma in engineering or a Bachelor degree in technology.

The degree certificate is bilingual (Swedish/English) and accompanied by a Diploma Supplement (in English).

### **Other Information**

Teaching is in the form of courses consisting typically of 7.5 higher education credits. The format of the courses can vary but they are normally in the form of lectures, seminars and assignments. Students work both individually and in groups depending on the format of the course in question.

Examination is in the form of home assignments, written exams and/or presentations at seminars. Teaching and examination are presented further in the course syllabi. The language of instruction is English.