Linnæus University

Jnr: 2014/2309-3.1.1.

Programme syllabus

Faculty of Technology

Matematik och modellering, masterprogram, 120 högskolepoäng
Mathematics and Modelling, Master Programme, 120 credits

Level
Second Level

Date of Ratification
Approved 2009-03-26
Revised 2014-09-03 by the Faculty Board within the Faculty of Technology
The programme syllabus is valid from autumn semester 2015

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

- Bachelor Degree in Mathematics, Physics, Electronics, Computer Science, Economics or the equivalent, including 60 credits in Mathematics
- English B/6 or the equivalent.

Description of Programme

The aim of the programme is to provide the students with extended depth of knowledge in Mathematics and Applied Mathematics and an ability to develop mathematical models in an area of application.

Algebra with Cryptography and Coding specialization:
The students should acquire the knowledge and abilities to make them attractive for companies in telecommunications and information security. The students will have the opportunity to start a PhD-education in Mathematics and Mathematical Modelling.

Analysis and Mathematical Physics specialization:
The students should acquire the requisite knowledge and abilities to make them attractive for companies making use of mathematical analytical methods in their work. Students will have opportunities to start on a PhD programme in Mathematics and Mathematical Modelling.

Mathematical Statistics and Financial Mathematics specialization:
Students should acquire the requisite knowledge and abilities to make them attractive for companies and institutions making use of statistics and statistical approaches, especially for insurance companies and banks. Students will have the opportunity to start a PhD-programme in Mathematics, Mathematical Modelling and Economics.

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

Upon completion of the master's degree programme, students should be able to demonstrate:
- demonstrate a broad knowledge of mathematics and profound knowledge and a deeper methodological knowledge in the chosen specialization.

Skills and ability

Upon completion of the master's degree programme, students should be able to demonstrate the ability to :

-critically and systematically integrate knowledge in Pure and Applied Mathematics and analyse and manipulate mathematical models
-critically, individually and creatively identify questions in pure mathematics and be able to build models.

Judgement and approach

Upon completion of the master's degree programme, students should be able to demonstrate the ability to:

- make judgements with regards to relevant scientific and social perspectives for mathematical modelling in Economics and Information Technology.

Content

Programme Overview

The degree program comprises 120 credits and includes a final degree project consisting of 30 credits.
The programme has three separate specializations: (1) Algebra with Cryptography and Coding, (2) Analysis and Mathematical Physics, (3) Mathematical Statistics and Financial Mathematics. Several courses are common to all specializations.

The degree programme is primarily aimed at two groups of students: students with Mathematics as their main subject and students with Physics, Engineering, Computer science or Economics as their main subject but with 60 credits in Mathematics. During the first term the two groups study alongside each other. Several important courses are common for the specializations, as described below. This together with a flexible organization makes it possible to change specialization and to study courses in connection with a research subject at the University.

Programme Courses

* Courses in the Main field of study: Mathematics

Algebra with Cryptography and Coding specialization

Year 1

- Analytic Functions (7.5 credits, A1N *) Introductory course in complex analysis
- Algebraic Structures II (7.5 credits, A1N *) Advanced course in group and ring theory
- Functional Analysis (7.5 credits, A1N *) The theory of metric and normed spaces and the theory of linear operators.
- Foundations of Probability (7.5 credits, A1N *) The mathematical foundation for the theory of probability based on measure and integration theory.
- Mathematical Cryptography (7.5 credits, A1F *) Public Key Cryptosystems and information theory
- Dynamical Systems (7.5 credits, A1N *)
- Mathematical Modelling II (7.5 credits, A1F *) Modelling and problem solving, report writing with LaTeX, and a large project.
- Elective course (7.5 credits)

Year 2

- Coding Theory (7.5 credits, A1F *) Introduces the most common methods in error correcting coding.
- Algebraic Structures II (7.5 credits, A1N *) Advanced course in group and ring theory
- Research Methodology (7.5 credits, A1F *) Theory of science, research methodology, oral and written presentations, planning research projects.
- Elective course (15 credits)
- Degree Project (30 credits, A2E *)

Analysis and Mathematical Physics Specialization

Year 1

- Analytic Functions (7.5 credits, A1N *) Introductory course in complex analysis
- Functional Analysis (7.5 credits, A1N *) The theory of metric and normed spaces and the theory of linear operators.
- Foundations of Probability (7.5 credits, A1N *) The mathematical foundation for the theory of probability based on measure and integration theory.
- Distribution Theory (7.5 credits, A1F *)Theory of distributions and their applications in mathematical physics
- Dynamical Systems (7.5 credits, A1N *) Introduction to the theory of non-linear dynamical systems
- Mathematical Modelling II (7.5 credits, A1F *) Modelling and problem solving, report writing with LaTeX, and a large project.
- Elective course (7.5 credits)

Year 2

- Partial Differential Equations (7.5 credits, A1F *)
- Research Methodology (7.5 credits, A1F *) Theory of science, research methodology, oral and written presentations, planning research projects.
- Elective course (15 credits)
- Degree Project (30 credits, A2E *)

Mathematical Statistics and Financial Mathematics

Year 1

- Analytic Functions (7.5 credits, A1N *) Introductory course in complex analysis
- Multivariate Analysis (7.5 credits, A1N *) Statistical methods for gathering information from multidimensional data
- Functional Analysis (7.5 credits, A1N *) The theory of metric and normed spaces and the theory of linear operators
- Foundations of Probability (7.5 credits, A1N *) The mathematical foundation for the theory of probability based on measure and integration theory
- Stochastic Analysis (7.5 credits, A1F *) Theory of stochastic differential equations. Pricing and hedging under Black-Scholes model
- Dynamical Systems (7.5 credits, A1N *) Introduction to the theory of non-linear dynamical systems
- Mathematical Modelling II (7.5 credits, A1F *) Modelling and problem solving, report writing with LaTeX, and a large project.
- Elective course(7.5 credits)

Year 2

- Insurance Mathematics (7.5 credits, A1F *) Principles for premium calculations, risk theory and probabilities for ruin and reinsurance
- Risk Theory (7.5 credits, A1F *) Investment and risk management decisions
- Financial Modelling (7.5 credits, A1F *) Modelling and pricing with Levy and jump processes
- Research Methodology (7.5 credits, A1F *) Theory of science, research methodology, oral and written presentations, planning research projects.
- Degree Project (30 credits, A2E *)

The elective courses are chosen in consultation with the programme coordinator. At most 30 credits of elective courses can be studied on bachelor level. There are among other subjects courses in algebra, number theory, cryptography, coding theory, financial modelling, insurance mathematics, mathematical foundations of quantum mechanics and quantum information, multivariate calculus, measure and integration theory, numerical methods with financial applications, topology.

Work Experience and Community Contacts

The programme's students will during the programme meet representatives from the working life. These contacts consist of field trips, projects, workshops and more. The workshops are mainly of a contact character where business problems are the focus, but also general issues occur. The main contact is in the final degree project which is for many designed to be a bridge to a future career in industry or academia. Students who choose the specialization in Mathematical Statistics and financial mathematics can be involved in projects with insurance companies and banks, but also other companies or institutions for statistical (including non-financial) projects. Students who choose the specialization Algebra with Cryptography and Coding may be involved in projects with companies that work with information security and information technology. Students who choose the specialization Analysis and Mathematical Physics may be involved in projects with companies that develop mathematical models within the industry.

Studies Abroad

There are opportunities to study at universities abroad as part of the programme. Course selection is done in consultation with the programme director to ensure validation within the degree programme.

Scope of Programme

- Sustainable development:

Mathematical models and simulations lead to a more effective way of using resources. Mathematics and modelling are hence important tools and analytical frameworks for a sustainable development.

- Internationalization:

The programme is taught in a very international environment. The programme usually has a large number of international students. Even among teachers and researchers many nationalities are represented. Periodically guest professors and other teaching staff are in attendance.

Quality Development

The programme is administered by a programme director who has the overall responsibility for the programme and is responsible for student contact.
Students are involved in both the program and course evaluations. The programme coordinator and the students meet regularly and discuss courses and help to choose the right specialization and elective courses. Compilations of course and program evaluations are filed by the department.

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 Mathematics and Modelling Master Programme, 120 higher education credits, may obtain the following degree:

Masterexamen
Huvudområde: Matematik
Inriktning: Algebra med kryptering och kodning alt. Analys och matematisk fysik alt. Matematisk statistik och finansmatematik

Master of Science (120 credits).
Main field of study: Mathematics/Applied Mathematics.
Specialization: Algebra with Cryptography and Coding, or Analysis and Mathematical Physics, or Mathematical Statistics and Financial mathematics

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