

MS in Technomathematics

Curriculum 2009-2010

The Master's Degree Programme in Technomathematics and Technical Physics corresponds to 120 ECTS credits and leads to the degree of Master of Science in Technology. This two-year M.Sc. programme is meant for both Finnish and international students. Lectures and tutoring are given in English. The M.Sc. programme has two alternative major subjects, Technomathematics and Technical Physics.

Technomathematics

Programme Coordinator in Technomathematics is lecturer, Ph.D. Matti Heiliö

Students majoring in Technomathematics should have a Bachelor's degree in engineering, applied mathematics, computer science or equivalent discipline. The aim is to develop the student's mathematical and computational skills for industry and other research and development tasks. The professional scope is wide-ranging and growing rapidly. Technomathematics is the art and science of applying mathematics and computational models into real life problems in industrial research and applied science, such as

- measurements, experiments and intelligent data-analysis
- modelling and simulation of systems and processes
- production management and process monitoring/control
- financial models, risk analysis and decision support systems

We train our graduates to combine modeling, computational skills, advanced theory and data analysis in innovative ways. We provide solutions to questions of industrial R&D. Some examples of applications and research areas: inverse problems, stochastic methods, Bayesian methods with MCMC, fuzzy logic and systems, fuzzy methods in knowledge engineering, data assimilation techniques, computational fluid dynamics, wavelets and image/signal analysis, data intensive methods in weather models, forest inventory and environmental monitoring.

Education in applied mathematics at LUT is international. One of our goals is the development of university pedagogy in applied mathematics education. We also provide the student with a capability for doctoral studies and independent research.

Requirements for Basic Studies

Students who choose the major in Technomathematics are expected to have a B.Sc. in applied mathematics, computer science or information technology. The students should have basic knowledge in computing including data structures and some programming skills. Furthermore, the students must have familiarity with PC work stations and basic data manipulation tools.

Regarding mathematics the student should master calculus, also in functions of several variables. He/she is assumed to know basics of matrices, linear algebra, differential equations and optimization, numerical algorithms, statistics and probability. Knowledge of discrete models, fuzzy models and methods is of great advantage. The student should have knowledge in physics covering basic phenomena in mechanics, electricity, thermal and wave phenomena. Independence, team work and communication skills are important. As tuition is given in English, the students must have good oral and writing skills in the English language.

Degree Structure

General Studies	9	ECTS cr
Major Subject, obligatory studies	13	ECTS cr
Major Subject, elective modules	30	ECTS cr
Minor Subject	20	ECTS cr
Elective Studies	18	ECTS cr
Master's Thesis and Seminar	30	ECTS cr
<i>Total</i>	<i>120 (min.)</i>	<i>ECTS cr</i>

General Studies 9 ECTS cr

<i>Obligatory Studies (9 ECTS cr)</i>	<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BK10A0300 Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
FV11A6500 Presenting in English	B.Sc. (Tech.) 2-3 M.Sc. (Tech.) 1-2	1, 2, 3, 4	2
FV11A8900 Academic Writing in English	B.Sc. (Econ. & Bus. Adm.) 2-3 M.Sc. (Econ. & Bus. Adm.) 1-2 B.Sc. (Tech.) 3 M.Sc. (Tech.) 1-2	1-2, 3-4	4
FV18A9101 Finnish 1	M.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 1-2	1, 3	2

Major Subject, obligatory studies 13 + 30 ECTS cr

<i>Obligatory Studies (43 ECTS cr)</i>	<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2101 Differential Equations	M.Sc. (Tech.) 1-2	3	5
BM20A2500 Linear Algebra and Normed Spaces	M.Sc. (Tech.) 1-2	1	3
BM20A4000 Case Study Seminar	M.Sc. (Tech.) 1	1-4	5
Thesis Master's Thesis and Seminar			30

Major Subject, elective modules 30 ECTS cr

Choose two modules from a-d. The extent of each module should be at least 15 ECTS cr.

a) Computational Modelling of Technical Systems

<i>Obligatory Studies (7 ECTS cr)</i>	<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2701 Numerical Methods II	M.Sc. (Tech.) 1	4	3
BM20A2800 Nonlinear Optimization	M.Sc. (Tech.) 1-2	4	4

<i>Elective Studies</i>	<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2000 Simulation	M.Sc. (Tech.) 1	1	4
BM20A2600 Integral Transforms	B.Sc. (Tech.) 3	4	3
BM20A3201 Fuzzy Engineering	M.Sc. (Tech.) 1-2	4	5
BM20A3801 Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4200 Applied Functional Analysis	M.Sc. (Tech.) 1-2	2-3	5
BM20A4500 Evolutionary Computation	M.Sc. (Tech.) 1-2	2	5

72 Technomathematics and Technical Physics**b) Data Analysis and Stochastics**

<i>Obligatory Studies (8 ECTS cr)</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A1900	Statistics II	M.Sc. (Tech.) 1- 2	2	3
BM20A3001	Statistical Analysis in Modelling	M.Sc. (Tech.) 1	2	5

<i>Elective Studies</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2000	Simulation	M.Sc. (Tech.) 1	1	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1- 2	4	5
BM20A3301	Stochastic Theory and Models	M.Sc. (Tech.) 1	4	3-5
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1- 2	3	4
BM20A3601	Fuzzy Data Analysis	M.Sc. (Tech.) 1- 2	3	5
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4500	Evolutionary Computation	M.Sc. (Tech.) 1- 2	2	5

c) Discrete and Fuzzy Models and Methods

<i>Obligatory Studies (6 ECTS cr)</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A3101	Fuzzy Sets and Fuzzy Logic	M.Sc. (Tech.) 1- 2	1-2	6

<i>Elective Studies</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2201	Logic and Discrete Methods	M.Sc. (Tech.) 1	4	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1- 2	4	5
BM20A3201	Fuzzy Engineering	M.Sc. (Tech.) 1- 2	4	5
BM20A3601	Fuzzy Data Analysis	M.Sc. (Tech.) 1- 2	3	5
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6

d) Theory of Applied Analysis

<i>Obligatory Studies (8 ECTS cr)</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A2600	Integral Transforms	B.Sc. (Tech.) 3	4	3
BM20A4200	Applied Functional Analysis	M.Sc. (Tech.) 1- 2	2-3	5

<i>Elective Studies</i>		<i>year</i>	<i>per.</i>	<i>ECTS cr</i>
BM20A1300	Complex Analysis	M.Sc. (Tech.) 1- 2	1	3
BM20A1900	Statistics II	M.Sc. (Tech.) 1- 2	2	3
BM20A2701	Numerical Methods II	M.Sc. (Tech.) 1	4	3
BM20A2800	Nonlinear Optimization	M.Sc. (Tech.) 1- 2	4	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1- 2	4	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	M.Sc. (Tech.) 1- 2	1-2	6
BM20A3301	Stochastic Theory and Models	M.Sc. (Tech.) 1	4	3-5
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6

Minor Subject 20 ECTS cr

Students can choose any minor subject taught at LUT if the required prerequisites are completed. Minor in Intelligent Computing is recommended only for the students of Technomathematics. The choice of the minor subject should be discussed with the Programme Coordinator in Technomathematics.

Minor: Intelligent Computing. Recommended for Technomathematics Students only

<i>Choose minimum 20 credits</i>		<i>per.</i>	<i>ECTS cr</i>
CT50A4000	Introduction to Intelligent Computing	3-4	5
CT50A5700	Introduction to Computer Graphics	2	5
CT50A6000	Pattern Recognition	3-4	7
CT50A6100	Machine Vision and Digital Image Analysis	1-2	7
CT50A6200	Computer and Robot Vision	1-2	7

Elective Studies 18 ECTS cr

Elective studies can include any courses offered by LUT if the required prerequisites are completed. Studies in other universities may be included upon application. Elective studies may include a maximum of 6 ECTS credits of internship improving expertise. The student should discuss the choice of elective courses with the Programme Coordinator.

Master's Thesis and Seminar 30 ECTS cr

Thesis topics arise from various application areas, research projects and contacts with industry. Typically, the thesis contains a theoretical study, as well as the use of up-to-date mathematical and computational methods for solving an application practical problem.

Minor in Technomathematics 20 ECTS cr

Minor in Technomathematics can be studied by students of other Master's degree programmes. Courses for minor studies can be freely chosen from the courses that Laboratory of Applied Mathematics offers in English. However, suitable background knowledge is needed. This means basic knowledge about matrix calculation, optimization, statistics, numerical analysis and especially mathematical programming with some procedural language (preferably Matlab/Octave).

A minimum of 20 ECTS credits should be selected from the courses below:

<i>Minor Studies min. 20 ECTS cr</i>		<i>per.</i>	<i>ECTS cr</i>
BM20A1300	Complex Analysis	1	3
BM20A1900	Statistics II	2	3
BM20A2000	Simulation	1	4
BM20A2101	Differential Equations	3	5
BM20A2201	Logic and Discrete Methods	4	4
BM20A2500	Linear Algebra and Normed Spaces	1	3
BM20A2600	Integral Transforms	4	3
BM20A2701	Numerical Methods II	4	3
BM20A2800	Nonlinear Optimization	4	4
BM20A2901	Discrete Optimization	4	5
BM20A3001	Statistical Analysis in Modelling	2	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	1-2	6
BM20A3201	Fuzzy Engineering	4	5
BM20A3301	Stochastic Theory and Models	4	3-5
BM20A3401	Design of Experiments	3	4
BM20A3601	Fuzzy Data Analysis	3	5
BM20A3801	Advanced Mathematical Methods	1-4	3-6
BM20A3900	Modelling Methodology in Process Engineering	1-2	6
BM20A4200	Applied Functional Analysis	2-3	5
BM20A4500	Evolutionary Computation	2	5

Additional Information

Personal Study Plans

At the beginning of their studies, students prepare a personal study plan, in which the student and the contact persons of the degree programme agree on what studies the student will pursue and in what order. This plan includes detailed information on the major subject, minor subject, general studies, elective studies, credit transfer from previous degree/studies and possible complementary studies.

Credit Transfers

ECTS credits can be transferred from the student's previous university level studies or higher university degrees from Finnish or foreign universities. More information on credit transfer is available from Study Coordinator.

Complementary Studies (20-60 ECTS cr)

Students with a Finnish degree from the University of Applied Sciences or equivalent will have to study complementary studies. The extent of these studies depends on the content of the previous degree. The course FV13A1200 Teknisk svenska 2 ECTS cr is obligatory for Finnish students who have not attained proficiency in Swedish in their previous degree.

Further Information

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