



Study blocks for the Techno-Mathematics Master

- **Block A:** Prerequisites (for admission to the Master programme)

Required topics

Basic knowledge in calculus	18 ECTS
Linear Algebra	6 ECTS
Some basics in numerical analysis	6 ECTS
Programming skills	6 ECTS
Basic knowledge in physics or mechanics	6 ECTS
Basics in statistics	6 ECTS
Total amount of courses	48 ECTS

- **Block B:** At least $\frac{1}{2}$ of the listed topics are required for admission.
The remaining topics are required during the Master study.

Required Topics:

Transforms, linear systems, basics in ODE	6 ECTS
Basics in PDE	6 ECTS
Numerics for differential equations	6 ECTS
Minor field of study related to mathematics	6 ECTS
Total amount of courses	at least 24 ECTS

- **Block C:** Elective courses in the field of industrial mathematics.
Every student can choose among offered specialization courses at her/his home university or at an ECMI partner university.

Requirements:

Total amount of courses in block C	at least 60 ECTS
among these courses:	
Mathematical courses	at least 42 ECTS
Courses in a minor field of study related to mathematics	at least 12 ECTS

Modelling activities

International ECMI modelling week	3 ECTS
Further modelling activities (European Summer School, project, study groups, internships etc.)	6 ECTS



Master thesis The thesis should be related to a real industrial problem. It could preferably be carried out in an interdisciplinary environment involving participants from industry
ECTS 30

Details on the topics in block B for the Techno-Math. Master

Transforms, linear systems, basics in ODE: (examples of topics)

- Fourier series, Fourier and Laplace transforms
- Systems of linear differential equations (state space theory, diagonalization, stability)
- Quadratic forms
- Input-output relations (transfer function, impulse response)

Basics in PDE: (examples of topics)

- First order PDE
- Linear second order PDE
- Series expansions
- Fourier's method
- Green function
- Wave propagation
- Functions spaces and norms
- Distributions

Numerics for differential equations: (examples of topics)

- Methods for time integration
- Finite difference methods
- Explicit and implicit Runge-Kutta
- Multistep methods
- Error analysis, stability and convergence

Examples for courses in block C for the Techno-Math. Master

at University Carlos III Madrid

Singular Perturbations	AMS 32D15, 35B25, 76M45
Computational Fluid Dynamics	AMS 76M10,12,15,20,22,23, 25
Combustion	AMS 80A25, PACS 47.70.Pq, 82.33.Vx
Electronic Transport in Micro and Nanostructures	PACS 73.63.-b, 72.10.-d,72.20.Ht
Inverse problems and Imaging	AMS 92C55, PACS 87.57.-s 87.85.Pq

at Lappeenranta University of Technology

Design of Experiments (4 ects)	62Kxx
Simulation (4 ects)	68U20, 81T80
Statistical analysis in modelling (5 ects)	62F15, 62F25
Evolutionary computation (5 ects)	68W20,90C15, 90C59
Fuzzy data analysis (5 ects)	90C70, 62H30



Alternative titles

Applied functional analysis (5 ects)
Stochastic theory and models (5 ects)
Numerical Methods II (3 ects)
Statistics II (3 ects)
Nonlinear Optimization (4 ects)
Case Study Seminar (5 ects)

at Lund University

Image Analysis	AMS 62M40, 65D18
Monte Carlo and Empirical Methods for Stochastic Inference	AMS 65C05, 80M31
Electromagnetic Wave Propagation	AMS 78-XX, 35Q6
Mechanical Wave Propagation	AMS 74Jxx
Multivariable Control	AMS 93-XX, 34Hxx

at the Technische Universität Dresden

FEM - Theory, Implementation, and
Applications
Phase Field Modelling
Discrete Optimization
Optimal Control of elliptic and parabolic
PDE systems
Dynamical Systems
Kinematical Geometry
Simulation of Stochastic Processes

Minor field of study related to mathematics

E.g. courses in one of the following fields:

- advanced programming
- physics
- mechanics
- electrical engineering
- signal processing
- image processing
- automatic control
- biotechnology