HOCHSCHULE MITTWEIDA
University of Applied Sciences

Mathematical Knowledge Required for the
Master's Programme in Applied Mathematics in Network and Data Sciences

When applying, prospective students confirm that they have already acquired the following mathematical knowledge during their Bachelor's programme and are familiar with it. They will then receive provisional admission. Enrolment in the programme will then only take place once a test has been successfully completed in the first semester to demonstrate that students have acquired this knowledge.

The areas of knowledge that must be self-declared as acquired and demonstrated during the first semester of study are:

Analysis
- convergence of sequences and series in R^n
- theory of (Riemann) integration and differentiation (in several variables)
- Taylor/Fourier series / transformations (Fourier/Laplace)
- topological basics (open, closed, compact sets)
- Hilbert-/Banach-spaces

Algebra
- group theory, ring, fields
- homeo-/iso-morphisms
- eigen-values, eigen-vectors
- linear operators
- Galois theory

Discrete Mathematics
- logic, sets and relations
- mathematical induction
- pigeonhole principle
- counting techniques
- generating functions

Number Theory
- well-ordering principle
- primality and coprimality
- modular arithmetics
- continued fractions
- RSA cryptosystem

Differential equations
- ODEs (homogeneous, inhomogeneous) (higher order linear, separation of variables, Bernoulli equ., exact diff. equ., existence and uniqueness results)
- PDEs (elliptic, parabolic, hyperbolic and classical solution methods for Laplace, Poisson, heat and wave equ.)
- systems of ODEs
- dynamical systems
- principles of self-organization

Numerical Methods/Mathematics
- linear systems
- eigen methods
- pseudo-inverses
- Taylor series

Measure and Probability Theory
- Zero-measures
- Expectations
- dsitribution/densities
- independence and contitional probabilities
- laws of large numbers and central limit theorem

Statistics
- expectation, variance, higher moments
- probability distributions
- confidence intervals
- descriptive statistics
- hypothesis testing

Graph Theory
- graphs, digraphs and hypergraphs
- matrix representations
- graph algorithms and complexity
- matroids
- Ramsey theory

Mathematical Modelling
- dynamical systems
- Fokker-Planck-Formalism
- Synergetics
- phase transitions
- stability

Optimization
- unsconstrained and constrained optimization
- linear programming
- convex optimization
- gradient-based methods
- linear optimization