Module title				Abbreviation
Fundamentals Advanced Mathematics				10-M-SPZ-G-131-m01
Module coordinator			**Module offered by**	
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**		
8	(not) successfully completed	--		
Duration	**Module level**	**Other prerequisites**		
1 semester	undergraduate	--		

Contents

One of the following topics in pure or applied mathematics which has not been chosen as subject of assessment in module 10-M-ANW-Ü or 10-M-REI-Ü:
Numerical Mathematics 1 (Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration)
Numerical Mathematics 2 (Solution methods and applications for eigenvalue problems, linear programming, initial value problems for ordinary differential equations, boundary value problems)
Stochastics 1 (Combinatorics, Laplace models, selected discrete distributions, elementary measure and integration theory, continuous distributions: normal distribution, random variable, distribution function, product measures and stochastic independence, elementary conditional probability, characteristics of distributions: expected value and variance, limit theorems: law of large numbers, central limit theorem)
Stochastics 2 (Elements of data analysis, statistics of data in normal and other distributions, elements of multivariate statistics)
Introduction to Algebra (Fundamental algebraic structures: groups, rings, fields; Galois theory)
Introduction to Differential Geometry (Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds in Euclidean spaces, hypersurfaces in particular, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces)
Ordinary Differential Equations (Existence and uniqueness theorem; continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order)
Introduction to Complex Analysis (Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps)
Geometric Analysis (Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology)
Introduction to Projective Geometry (Projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces)
Introduction to partial differential equations (Examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.)
Introduction to Discrete Mathematics (Techniques from combinatorics, introduction to graph theory including applications, cryptographic methods, error-correcting codes)
Introduction to Functional Analysis (Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis)
Operations Research (Linear programming, duality theory, transport problems, integral linear programming, graph theoretic problems)
Introduction to Number Theory (Elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainder, quadratic forms, diophantine approximation and diophantine equations).

Intended learning outcomes

The student knows and masters the essential methods and basic notions in one branch of pure or applied mathematics. He/She is acquainted with the central concepts in this field, and is able to apply the fundamental proof methods independently.

Courses (type, number of weekly contact hours, language — if other than German)
V + Ü (no information on SWS (weekly contact hours) and course language available)
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
written examination (approx. 90 to 180 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English
Allocation of places
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Additional information
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Workload
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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Mathematics (2014)