Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Module Catalogue

for the Subject

Mathematics

as vertieft studiertes Fach (studied with a focus on the scientific discipline)
with the degree "Erste Staatsprüfung für das Lehramt an Gymnasien"

Examination regulations version: 2015
Responsible: Faculty of Mathematics and Computer Science
Responsible: Institute of Mathematics

Contents

The subject is divided into

Learning Outcomes

German contents and learning outcome available but not translated yet.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen sind vertraut mit den Arbeitsweisen und der zugehörigen Fachsprache der Mathematik und beherrschen die Methoden mathematischen Denkens und Beweisens.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse in Stochastik und mindestens einem weiteren Gebiet der Angewandten Mathematik und können sicher mit den Methoden dieser Gebiete umgehen.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse ausgewählter Gebiete der Reinen Mathematik und sind vertraut mit den grundlegenden Beweismethoden dieser Gebiete.
- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, sich selbständig mithilfe von Fachliteratur in weitere Gebiete der Mathematik einzuarbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen verständlich zu präsentieren.
- Die Absolventinnen und Absolventen besitzen die für ein weiterführendes, insbesondere Master-
- Studium, erforderlichen Grundkenntnisse, Denk- und Arbeitsweisen und Methodenkenntnisse.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie in ihrer eigenen Arbeit zu beachten.
- Die Absolventinnen und Absolventen können Konzepte, Prinzipien, Methoden und evidenzbasierte Erkenntnisse aus dem Bereich der Mathematikdidaktik interpretieren und anwenden.
- Die Absolventinnen und Absolventen können den Einsatz von Medien im Mathematikunterricht und die Betreuung von Schülerinnen und Schülern an ausgewählten Lehr-Lernsituationen wissenschaftlich fundiert reflektieren.

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen zielgruppenorientiert verständlich zu formulieren und zu präsentieren.
- Die Absolventinnen und Absolventen sind in der Lage, konkrete Probleme aus anderen Gebieten zu erkennen, strukturieren und modellieren, mit mathematischen Methoden Lösungswege zu entwickeln.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in Teams zu arbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, sich weitere Wissensgebiete selbständig, effizient und systematisch zu erschließen.
- Die Absolventinnen und Absolventen sind vertraut mit dem Umgang von digitalen Medien im Mathematikunterricht und können mathematische Software gewinnbringend in Lehr-Lernsituationen einsetzen.

- Die Absolventinnen und Absolventen besitzen die Fähigkeit, in interdisziplinär zusammengesetzten Teams gestaltend mitzuwirken.
- Die Absolventinnen und Absolventen realisieren Konzepte, Prinzipien, Methoden und evidenzbasierte Erkenntnisse aus dem Bereich der Mathematikdidaktik im Mathematikunterricht.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, gesellschaftliche, wirtschaftliche, historische, fachdidaktische und schulpraktische Entwicklungen und Prozesse kritisch zu reflektieren und zu bewerten.
- Die Absolventinnen und Absolventen sind in der Lage, in partizipativen Prozessen gestaltend mitzuwirken.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, Ideen und Lösungsvorschläge allgemeinverständlich und zielgruppenorientiert zu identifizieren, realisieren und präsentieren.

Abbreviations used

Course types: **E** = field trip, **K** = colloquium, **O** = conversatorium, **P** = placement/lab course, **R** = project, **S** = seminar, **T** = tutorial, **Ü** = exercise, **V** = lecture

Term: **SS** = summer semester, **WS** = winter semester

Methods of grading: **NUM** = numerical grade, **B/NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

LASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

03-Nov-2015 (2015-190)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

Scientific Discipline

(92 ECTS credits)

Compulsory Courses

(28 ECTS credits)

Module title			Abbreviation
Introduction into Mathematical Thinking and Working for Teaching Degree (German Gymnasium)			10-M-MDAL-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Logical foundations of mathematical proofs, in particular axiomatic and deduction; basic concepts in mathematics, e. g. sets and functions; basic techniques and methods for proving; mathematical writing.

Intended learning outcomes

The student is acquainted with the basic proof methods and techniques in mathematics. He/She is able to perform easy mathematical arguments independently and present them adequately and reasonably in written and oral form.

Courses (type, number of weekly contact hours, language — if other than German)

V (1) + Ü (1) + V (1) + Ü (1)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (10 to 15 pages)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: includes block taught sessions prior to the beginning of the lecture period.

Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (1 ECTS credits)
§ 73 I Nr. 3 (2 ECTS credits)
§ 73 I Nr. 5 (2 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Overview Linear Algebra and Number Theory for Teaching Degree (German Gymnasium)			10-M-LNL-Ü-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic notions and structures; vector spaces, linear maps and systems of linear equations; theory of matrices and determinants; eigenvalue theory; bilinear forms and Euclidean/unitary vector spaces; diagonalisability and Jordan normal form.

Intended learning outcomes

The student knows and masters the essential methods and proof techniques of linear algebra and is able to apply them independently. He/She has an overview over the fundamental notions and methods of linear algebra, knows about their algebraic and geometric background, is able to relate them to each other and can present them adequately in written and oral form.

Courses (type, number of weekly contact hours, language — if other than German)

V (6) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-LNL1 and 10-M-LNL2.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Overview Analysis for Teaching Degree (German Gymnasium)			10-M-ANL-Ü-152-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	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Real numbers and completeness, basic topological notions, convergence and divergence of sequences and series, differential and integral calculus in one variable, further topological considerations, differential calculus with a focus on functions in several variables.

Intended learning outcomes

The student knows and masters the essential methods and proof techniques of analysis and is able to apply them independently, He/She has an overview over the fundamental notions and concepts of analysis, their analytic background and geometric interpretation, and can interconnect them and express them adequately in written and oral form.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-ANL1 and 10-M-ANL2.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Review Course for Teaching Degree (German Gymnasium)			10-M-REPL-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Revision and consolidation of the topics covered in the state examination (analysis; linear algebra, algebra and number theory; didactics of mathematics) by completing exercises and answering past state examination questions.

Intended learning outcomes

The student has advanced knowledge in the topics stated in LPO I (examination regulations for teaching degree programmes), §73 (2), and is able to apply them on the level of the state examination.

Courses (type, number of weekly contact hours, language — if other than German)

S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) talk (approx. 45 minutes) or
b) project (10 to 15 pages)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I special branch of science without assignment

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Compulsory Electives

(64 ECTS credits)

Subfield Basics of Linear Algebra and Number Theory

(8 ECTS credits)

Module title			Abbreviation
Linear Algebra 1 for Teaching Degree (German Gymnasium)			10-M-LNL1-152-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

Basic notions and structures; vector spaces, linear maps, systems of linear equations; theory of matrices and determinants.

Intended learning outcomes

The student knows and masters the basic notions and essential methods of linear algebra. He/She is acquainted with the central proof methods in linear algebra and can apply them to solve easy problems. He/She is able to perform simple mathematical arguments independently, and can present them adequately in written form.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

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) and written exercises (approx. 10 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Linear Algebra 2 for Teaching Degree (German Gymnasium)			10-M-LNL2-152-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

Eigenvalue theory, bilinear forms, Euclidean and unitary vector spaces, diagonalisability and Jordan normal form; elementary divisibility properties, prime numbers and factorisation, modular arithmetics, prime number tests and methods for factorisation, structure of residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student knows and masters the basic notions and essential methods of linear algebra and number theory. He/She is acquainted with the central proof methods in linear algebra and number theory, and can apply them to solve easy problems. He/She is able to perform simple mathematical arguments independently, and can present them adequately in written form.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2) + V (2)

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) and written exercises (approx. 10 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Basics of Analysis

(7 ECTS credits)

Module title			Abbreviation
Analysis 1 for Teaching Degree (German Gymnasium)			10-M-ANL1-152-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)**	
7	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Real numbers and completeness; basic topological notions; convergence and divergence of sequences and series; power series and Taylor series; basics in differential calculus in one variable; basics of integral calculus in one variable (Riemann integral and improper integral).

Intended learning outcomes

The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

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) and written exercises (approx. 10 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

210 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Analysis 2 for Teaching Degree (German Gymnasium)			10-M-ANL2-152-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)**	
7	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Further topological considerations, basics in differential calculus in several variables, inverse function theorem, implicit function theorem.

Intended learning outcomes

The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

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) and written exercises (approx. 10 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

210 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Basics of Higher Analysis

(7 ECTS credits)

Module title			Abbreviation
Ordinary Differential Equations for Teaching Degree (German Gymnasium)			10-M-DGLL-152-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)**	
7	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

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.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of the theory of ordinary differential equations. He/she is able to apply these methods to practical problems.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

210 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Introductory Complex Analysis for Teaching Degree (German Gymnasium)			10-M-FTHL-152-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)**	
7	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

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.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in complex analysis. He/she is able to apply these methods to practical problems.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

210 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Advanced Analysis for Teaching Degree (German Gymnasium)			10-M-VANL-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Continuation of analysis in several variables.

Intended learning outcomes

The student is acquainted with advanced topics in analysis. Taking the example of the Lesbegue integral, he or she is able to understand the construction of a complex mathematical concept.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

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 exercises (approx. 10 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Basics of Algebra and Geometry

(8 ECTS credits)

Module title			Abbreviation
Introductory Algebra for Teaching Degree (German Gymnasium)			10-M-ALGL-152-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

Fundamental algebraic structures (groups, rings, fields), Galois theory.

Intended learning outcomes

The student knows and masters the essential methods and basic notions in algebra. 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 (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (4 ECTS credits)
§ 73 I Nr. 4 (4 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Introductory Differential Geometry for Teaching Degree (German Gymnasium)			10-M-DGEL-152-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

Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student knows and masters the essential methods and basic notions in differential geometry. 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 (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (4 ECTS credits)
§ 73 I Nr. 4 (4 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Introductory Projective Geometry for Teaching Degree (German Gymnasium)			10-M-PGEL-152-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

Projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of projective geometry. He/she is able to apply these methods to practical problems.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (4 ECTS credits)
§ 73 I Nr. 4 (4 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Basics of Stochastic and Applied Mathematics

(6 ECTS credits)

Module title			Abbreviation
Stochastics for Teaching Degree (German Gymnasium)			10-M-STL-152-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)**	
6	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discrete statistics, in particular stochastic modelling, motivation of conceptualisation and discussion of basic assumptions: basic notions of descriptive statistics, discrete probability spaces, random variables, important discrete distributions, elements of combinatorics, principle of inclusion and exclusion, multistage experiments, conditional probability, stochastic independence, common distributions, expected value and variance, covariance and correlation, waiting time problems, law of the large numbers, central limit theorem, confidence intervals and statistical tests in binomial models, stochastic paradoxes.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods of stochastics, as required for teaching at German Gymnasium. He/She is able to assess stochastic phenomena correctly and handle the concept of statistical significance.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 3 (3 ECTS credits)
§ 73 I Nr. 5 (3 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Numerical Mathematics 1 for Teaching Degree (German Gymnasium)			10-M-NUL1-152-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)**	
6	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

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.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in numerical mathematics, applies them to practical problems and knows about their typical fields of application.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 3 (3 ECTS credits)
§ 73 I Nr. 5 (3 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Introductory Discrete Mathematics for Teaching Degree (German Gymnasium)			10-M-DIML-152-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)**	
6	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes.

Intended learning outcomes

The student is acquainted with the fundamental concepts and results in discrete mathematics, masters the relevant proof techniques, is able to apply methods from number theory and algebra to discrete mathematics and realises the scope of applications of discrete structures.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 3 (3 ECTS credits)
§ 73 I Nr. 5 (3 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Overview Higher Analysis

(10 ECTS credits)

Module title			Abbreviation
Overview Differential Equations and Complex Analysis for Teaching Degree (German Gymnasium)			10-M-DFL-Ü-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

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; 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.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in complex analysis and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-DGLL and 10-M-FTHL.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Overview Complex Analysis and Advanced Analysis for Teaching Degree (German Gymnasium)			10-M-FVL-Ü-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Advanced analysis of functions in several variables, integral theorems; 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.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in analysis of several variables (including integral theorems) and complex analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-FTHL and 10-M-VANL.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 1

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Overview Algebra and Geometry

(10 ECTS credits)

Module title			Abbreviation
Overview Algebra and Differential Geometry for Teaching Degree (German Gymnasium)			10-M-ADGL-Ü-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and differential geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-ALGL and 10-M-DGEL.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (5 ECTS credits)
§ 73 I Nr. 4 (5 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Overview Algebra and Projective Geometry for Teaching Degree (German Gymnasium)			10-M-APGL-Ü-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and projective geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-ALGL and 10-M-PGEL.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 2 (5 ECTS credits)
§ 73 I Nr. 4 (5 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Subfield Overview Stochastics and Applied Mathematics

(8 ECTS credits)

Module title			Abbreviation
Overview Stochastics and Numerical Mathematics 1 for Teaching Degree (German Gymnasium)			10-M-SNL-Ü-152-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	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discrete stochastics, in particular stochastic modelling, motivation of conceptualisation and discussion of basic assumptions: basic notions of descriptive statistics, discrete probability spaces, random variables, important discrete distributions, elements of combinatorics, principle of inclusion and exclusion, multistage experiments, conditional probability, stochastic independence, common distributions, expected value and variance, covariance and correlation, waiting time problems, law or large numbers, central limit theorem, confidence intervals and statistical tests in binomial models, stochastic paradoxes; 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.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in stochastics and numerical mathematics as required for teaching mathematics at German Gymnasium. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-STL and 10-M-NUL1.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 3 (4 ECTS credits)
§ 73 I Nr. 5 (4 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Overview Stochastics and Discrete Mathematics for Teaching Degree (German Gymnasium)			10-M-SDL-Ü-152-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	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discrete stochastics, in particular stochastic modelling, motivation of conceptualisation and discussion of basic assumptions: basic notions of descriptive statistics, discrete probability spaces, random variables, important discrete distributions, elements of combinatorics, principle of inclusion and exclusion, multistage experiments, conditional probability, stochastic independence, common distributions, expected value and variance, covariance and correlation, waiting time problems, law or large numbers, central limit theorem, confidence intervals and statistical tests in binomial models, stochastic paradoxes; techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in stochastics and discrete mathematics as required for teaching mathematics at German Gymnasium. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-STL and 10-M-DIML.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 3 (4 ECTS credits)
§ 73 I Nr. 5 (4 ECTS credits)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Teaching

(10 ECTS credits)

Compulsory Courses

(10 ECTS credits)

Module title			Abbreviation
Didactics of Mathematics: Geometry and Analysis (German Gymnasium)			10-M-DGY1-152-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)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
2 semester	undergraduate	--	

Contents

Discussion of advanced topics in mathematics didactics for Gymnasium using the examples of geometry (Sekundarstufe I) analysis (Sekundarstufe II) as well as discussion of possibilities of implementation in the classroom, also including modern technologies.

Intended learning outcomes

The student is acquainted with mathematical ways of thinking and working techniques (in particular in the fields of geometry in Sekundarstufe I and analysis in sekundarstufe II) and is able to take into account the student-s'perception of mathematical topics, He/She knows different aspects of planning and analysing teaching of mathematics, masters different strategies for teaching and learning und can assess them.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2) + V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (60 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2 to 3 candidates, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 6

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Didactics of Mathematics: Algebra (German Gymnasium)			10-M-DGY2-152-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)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of basic topics in mathematics didactics for Gymnasium using the example of algebra (Sekundarstufe I) as well as discussion of possibilities of implementation in the classroom, also including modern technologies.

Intended learning outcomes

The student is acquainted with basic mathematical ways of thinking and working techniques (in particular in the field of algebra in Sekundarstufe I) and is able to take into account the students'perception of mathematical topics, He/She knows important aspects of planning and analysing teaching of mathematics, masters different strategies for teaching and learning und can assess them.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (60 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2 to 3 candidates, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 73 I Nr. 6

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
exchange program Mathematics (2023)

Intership in school

(4 ECTS credits)

Students studying for a teaching degree Gymnasium must complete a practical training in didactics and teaching methodology (studienbegleitendes fachdidaktisches Praktikum) which refers to one of the subjects they selected as vertieft studiertes Fach (subject studied with a focus on the scientific discipline) pursuant to Section 34 Subsection 1 No. 4 LPO I (examination regulations for teaching-degree programmes). The obligatory accompanying tutorial is offered by the respective subject. The ECTS credits obtained are counted in the subject Erziehungswissenschaften pursuant to Section 10 Subsection 3 LASPO (general academic and examination regulations for teaching-degree programms).

Module title			Abbreviation
Practical Training in Classroom Teaching including Theory (German Gymnasium)			10-M-SFDPGY-152-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)**	
4	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The module introduces the student to the classroom practice of his/her Unterrichtsfach (subject studied with a focus on the scientific discipline) or Didaktikfach (subject studied with a focus on teaching methodology). Using specific teaching models, examples and projects in different grades, the module introduces the student to subject-specific techniques. In the university course accompanying the placement, the student reflects and structures what he/she has learned during his/her teaching placement and explores additional subject-specific and didactic aspects. In this context, the course discusses selected practical aspects of teaching mathematics in accordance with applicable guidelines and curricula. The course focuses on recent developments in classroom practice, also taking into account aspects of school pedagogy and learning psychology that can support the successful practical implementation of subject-specific conceptual designs.

Intended learning outcomes

The student is acquainted with the most important components of planning and organising teaching. He/She is able to teach the relevant topics for different forms, and can critically reflect the recent developments in the educational system. He/She is able to connect ideas from school pedagogy and learning psychology with didactical cognisance and incorporate them in the mise-en-scène of his/her teaching.

Courses (type, number of weekly contact hours, language — if other than German)

P (0) + S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) presentation (30 to 45 minutes) with position paper (1 to 2 pages) or
b) term paper (10 to 15 pages)
Contents and duration of placement as specified in Section 34 Subsection 1 Sentence 1 No. 4 LPO I (examination regulations for teaching-degree programmes); participation in mandatory teaching practice, completion of all set tasks as specified by placement school.

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 34 I 1 Nr. 4

Module appears in

First state examination for the teaching degree Gymnasium Educational Science (2015)

Freier Bereich (general as well as subject-specific electives)

(ECTS credits)

Teaching degree students must take modules worth a total of 15 ECTS credits in the area Freier Bereich (general as well as subject-specific electives) (Section 9 LASPO (general academic and examination regulations for teaching-degree programmes)). To achieve the required number of ECTS credits, students may take any modules from the areas below.
Freier Bereich -- interdisciplinary: The interdisciplinary additional offer for a teaching degree can be found in the respective Annex "Ergänzende Bestimmungen für den "Freien Bereich" im Rahmen des Studiums für ein Lehramt".

Mathematics

(ECTS credits)

(Freier Bereich (general as well as subject-specific electives) -- subject specific)

Module Group Mathematics and Teaching of Mathematics

(ECTS credits)

Module title			Abbreviation
School Mathematics from a Higher Perspective			10-M-SCH-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of selected topics in school mathematics with respect to their integration into wider theories and their didactic implementation at both school and university levels.

Intended learning outcomes

By means of selected examples, the student gains insight into the interrealtion between school mathematics and advanced mathematical theories. He/She is able to discuss these under mathematical, didactical and methodical aspect.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) talk (approx. 45 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Computers in Mathematical Teaching			10-M-DCMU-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of possible ways to use computers in teaching mathematics as well as discussion of common computer tools.

Intended learning outcomes

The student is acquainted with basic possibilities for the employment of computers in the teaching of mathematics, as well as with the potential and limitations of computer tools.

Courses (type, number of weekly contact hours, language — if other than German)

V (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (10 to 15 pages)
Assessment offered: Every two years, winter semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 2 f)
§ 22 II Nr. 1 h)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))

exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Introduction to Hands-on Mathematics			10-M-PRM1-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Elaboration of a school project on a topic in mathematics, e. g. for project days, school term papers (Facharbeiten), Pluskurse (additional courses for the in-depth study of areas of special interest), workshops. In the theoretical phase, the students formulate the subject-specific and didactic requirements of the topic, search for a suitable topic, elaborate this topic for the project and draw up a project plan. This is done in groups with students providing each other with advice as well as challenging and reflecting on each other's work.

Intended learning outcomes

The student is able to select a suitable mathematical topic for a school project and elaborate it.

Courses (type, number of weekly contact hours, language — if other than German)

S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (10 to 15 pages)
Assessment offered: Every two years, winter semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Practical Course Hands-on Mathematics			10-M-PRM2-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Implementation of a school project on a topic in mathematics, e. g. for project days, school term papers (Facharbeiten), Pluskurse (additional courses for the in-depth study of areas of special interest), workshops. In the practical phase the students prepare the implementation, realise the project with pupils and afterwards reflect the planning and implementation.

Intended learning outcomes

The student is able to perform a school project with a suitable mathematical topic. He/She is acquainted with different aspects of project planning and management, and can reflect the process critically.

Courses (type, number of weekly contact hours, language — if other than German)

P (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project: drawing up a project plan (5 to 10 pages) and practical implementation with pupils
Assessment offered: Every two years, summer semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Didactics of Mathematics: Analytic Geometry and Stochastics			10-M-D3GY-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of basic topics in mathematics didactics for Gymnasium using the examples of analytic geometry and stochastics (Sekundarstufe I) as well as discussion of possibilities of implementation in the classroom, also including modern technologies.

Intended learning outcomes

The student is acquainted with basic mathematical ways of thinking and working techniques (in particular in the fields of analytic geometry and stochastics in Sekundarstufe I) and is able to take into account the students'perception of mathematical topics, He/She knows important aspects of planning and analysing teaching of mathematics, masters different strategies for teaching and learning und can assess them.

Courses (type, number of weekly contact hours, language — if other than German)

V (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 90 minutes) or
b) oral examination of one candidate each (approx. 15 to 20 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 10 minutes per candidate)
Assessment offered: Every two years, summer semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

Module title			Abbreviation
Hands-on Seminar Mathematics			10-M-PRA-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Elaboration of a topic in the practical teaching of mathematics. This can either be a topic in "classical mathematics" (geometry, algebra, stochastics, analytic geometry, analysis) or a topic related to a school workshop, project, school term paper (Facharbeit) or Pluskurs (additional course for the in-depth study of areas of special interest): formulation of subject-related and didactic requirements, search for an appropriate topic, preparation of the topic for classroom practice. Usually the work will be done in groups and will be supervised and reflected by the lecturer.

Intended learning outcomes

The student is able to select and elaborate a suitable topic for teaching mathematics in school. He/She is acquainted with didactical and methodical aspects of selecting a topic, and is able to critically reflect the process.

Courses (type, number of weekly contact hours, language — if other than German)

S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project: drawing up a project plan (10 to 15 pages)
Assessment offered: Every two years, summer semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Selected Topics in History of Mathematics			10-M-GES-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Historical and cultural development as well as social relevance of mathematics; more in-depth discussion of the fundamentals of mathematics, in particular in its relation to other sciences and humanities as well as to the image of mathematics in modern society.

Intended learning outcomes

Based on selected examples, the student has gained insight into the historical and cultural genesis of mathematical theories and their social relevance. He/she is able to present mathematical ideas and concepts to a general audience.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) talk (45 to 90 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Mathematical Writing			10-M-MSC-152-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)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of good and bad mathematical writing using practical exercises and case examples. The course covers the whole range of mathematical texts from short proofs and the formulation of theorems and definitions to comprehensive works such as Bachelor's or Master's theses. Important aspects include not only mathematical rigour and efficiency but also didactic questions.

Intended learning outcomes

The student is able to formulate mathematical subject matter precisely and comprehensibly. He/She knows about the structures and conventions of mathematical literature and the requirements of scientific work.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) talk (45 to 90 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Seminar Mathematics			10-M-SEM-152-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)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

A selected topic in mathematics.

Intended learning outcomes

The student gains first experience with independent scientific work. He/She masters elaboration and structuring of a given topic using selected literature, and prepares a talk on the subject. He/She is able to participate actively in a scientific discussion.

Courses (type, number of weekly contact hours, language — if other than German)

S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

talk (60 to 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Computational Mathematics	10-M-COM-152-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)
4	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Introduction to modern mathematical software for symbolic computation (e. g. Mathematica or Maple) and numerical computation (e. g. Matlab) to supplement the basic modules in analysis and linear algebra (10-M-ANA-G and 10-M-LNA-G). Computer-based solution of problems in linear algebra, geometry, analysis, in particular differential and integral calculus; visualisation of functions.

Intended learning outcomes

The student learns the use of advanced modern mathematical software packages, and is able to assess their fields of application to solve mathematical problems.

Courses (type, number of weekly contact hours, language — if other than German)

V (1) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project in the form of programming exercises (approx. 20 to 25 hours)
Language of assessment: German and/or English
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Physics (2020)

Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Functional Materials (2025)
Bachelor's degree (1 major) Economathematics (2025)

Module title			Abbreviation
Programming course for students of Mathematics and other subjects			10-M-PRG-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basics of a modern programming language (e. g. C).

Intended learning outcomes

The student is able to work independently on small programming exercises and standard programming problems in mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

P (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project in the form of programming exercises (approx. 20 to 25 hours)
Language of assessment: German and/or English
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Functional Materials (2021)

Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Functional Materials (2025)
Bachelor's degree (1 major) Economathematics (2025)

Module title	Abbreviation
Exercise tutor or proof-reading in Mathematics	10-M-TuKo-152-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)
5	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Tutoring or grading homework for one of the basic courses in the Bachelor's or teaching degree programmes under supervision of the respective lecturer or exercise supervisor.

Intended learning outcomes

The student is able to support the acquisition of mathematical skills and knowledge. He/She helps to identify mistakes in mathematical proof exercises and to find possible solutions.

Courses (type, number of weekly contact hours, language — if other than German)

T (0)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment of tutoring activities or correcting work by supervising lecturers or exercise supervisors (1 to 2 teaching units or approx. 5 pieces of correcting work)

Allocation of places

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Additional information

Please direct application to teaching coordinator Mathematics, he/she will select participants.

Workload

150 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Economathematics (2025)

Module title			Abbreviation
Introduction to Functional Analysis			10-M-FAN-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis.

Intended learning outcomes

The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Geometric Analysis			10-M-GAN-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in geometric analysis. He/she is able to apply these methods to practical problems.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Operations Research			10-M-ORS-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Linear programming, duality theory, transport problems, integral linear programming, graph theoretic problems.

Intended learning outcomes

The student is acquainted with the fundamental methods in operations research, as required as a central tool for solving many practical problems especially in economics. He/She is able to apply these methods to practical problems, both theoretically and numerically.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module Group VHB Courses

(ECTS credits)

Module title			Abbreviation
E-Learning and Blended Learning in Mathematical Teaching (virtual Course)			10-M-DVHB-152-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

In a course offered by Virtuelle Hochschule Bayern (vhb), the student becomes acquainted with and reflects on techniques in e-learning and blended learning for teaching mathematics.

Intended learning outcomes

The student is acquainted with basic methods of e-learning and blended learning in teaching methematics, as well as their potentials and limitations.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Basics in Arithmetics (virtual course)			10-M-VHBAri-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic topics on teaching arithmetics in school, e. g. divisability theory, prime numbers, set theory.

Intended learning outcomes

The student learns basic topics in the teaching of arithmetics and the related mathematical backgrounds and proofs. He/She is acquainted with the employment of new technologies for teaching arithmetic in school.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))

First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Basics in School Geometry (virtual course)			10-M-VHBGeo-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Revision and consolidation of the fundamental topics in elementary geometry that are prerequisites for the subject-specific and didactic courses (in particular teaching degrees Grundschule, Hauptschule, Realschule) in geometry.

Intended learning outcomes

The student has basic knowledge of school geometry, as required for the study of mathematics and its didactics.He/She is acquainted with the employment of new technologies for teaching geometry in school.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Stochastics in Sekundarstufe I (virtual course)			10-M-VHBSto-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Revision and consolidation of the fundamental topics in stochastics that are prerequisites for the subject-specific and didactic courses in stochastics.

Intended learning outcomes

The student has basic knowledge of stochastics, as required for the study of mathematics and its didactics.He/She is acquainted with the employment of new technologies for teaching stochastics in school.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Mathematics in grade 10 (virtual course)			10-M-VHBM10-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic topics on teaching mathematics in tenth grade in Hauptschule, Realschule and Gymnasium.

Intended learning outcomes

The student learns basic topics in the teaching of mathematics in tenth form at German Mittelschule and Realschule, as well as the related mathematical backgrounds and proofs. He/She is acquainted with the employment of new technologies for teaching mathematics in tenth form.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Didactics of Geometry (virtual course)			10-M-VHBDG-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Geometry didactics is about learning and teaching geometry. This course focuses on topics which are central and important for all of geometry and mathematics, namely proving and problem solving. It also addresses topics which are usually discussed only briefly or not at all in university lectures and in the literature. Among these are chapters on space geometry, trigonometry and similarity geometry.

Intended learning outcomes

The students are acquainted with the subject-specific contents of school geometry, and are able to structure the notions and methods within a conceptual map. They know strategies of short, middle and long term development of understanding of the central concepts of geometry in teaching mathematics. They are able to develop and justify learning units and learning sequences for the important topics in school geometry independently. They are able to assess and value the importance of digital technology with respect to todays and future design of instruction. They know various fields of application of geometric concepts, and are able to perform modelling (in the sense of modelling cycles) independently.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)

First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)

Module title			Abbreviation
Didactics of Algebra (virtual course)			10-M-VHBDA-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Algebra didactics is about learning and teaching algebra. This course focuses on the central and important topics in school algebra: extensions of number domains, variables and terms, equations and functions.

Intended learning outcomes

The students are acquainted with the subject-specific contents of school algebra, and are able to structure the notions and methods within a conceptual map. They know strategies of short, middle and long term development of understanding of the central concepts of algebra in teaching mathematics. They are able to develop and justify learning units and learning sequences for the important topics in school algebra independently. They are able to assess and value the importance of digital technology with respect to todays and future design of instruction. They know various fields of application of algebraic concepts, and are able to perform modelling (in the sense of modelling cycles) independently.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h), § 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)

First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)

Module title			Abbreviation
Exam Tutorial Didactics of Mathematics (virtual course)			10-M-VHBEx-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Revision of basics (definitions of mathematical notions, formulation and proving of theorems) in preparation for the Erstes Staatsexamen für Lehramt Gymnasium (first state examination for teaching at a Gymnasium) as well as basic guidelines for answering exam questions (with a special focus on the state examination in Bavaria).

Intended learning outcomes

The student learns about the structure of the state exams and different methods for solving the exam problems.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))

First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))

Module title			Abbreviation
Exam Tutorial Algebra (virtual course)			10-M-VHBExA-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The exam course (university) algebra covers the central topics in classical algebra with respect to their relevance for the Bavarian state examination for the teaching degree Gymnasium. The theories of groups, rings and fields are addressed with equal importance, and fundamental algebraic concepts with their set-theoretic interrelations are discussed in detail. Each module contains problems of increasing difficulty and their solutions.

Intended learning outcomes

The student for the teaching degree for German Gymnasium knows the central problems and the respective algebraic proof methods and is able to apply them in different contexts. The course shows the level of difficulty in the Bavarian state examination.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Mathematics 1 (virtual course)			10-M-VHBMa1-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of basic topics on teaching mathematics in a Gymnasium, in particular verbal and subject-specific fundamentals concerning the organisation of classes.

Intended learning outcomes

The student is able to discuss selected topics and questions on teaching mathematics at German Gymnasium, considering both subject-related and methodical aspects.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Every two years, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Mathematics 2 (virtual course)			10-M-VHBMa2-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of central topics on teaching mathematics in a Gymnasium, in particular didactic analyses and possibilities of implementation in the classroom.

Intended learning outcomes

The student is able to discuss and analyse selected topics and questions on teaching mathematics at German Gymnasium from a didactical point of view.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Every two years, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Grundschule Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2015)
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Mittelschule Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Middle School) (2020 (Prüfungsordnungsversion 2015))
First state examination for the teaching degree Sonderpädagogik Didactics in Mathematics (Primary School) (2020 (Prüfungsordnungsversion 2015))
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Computer and Mathematics (virtual course)			10-M-VHBCom-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of possible ways to use computers in teaching mathematics as well as discussion of common computer tools.

Intended learning outcomes

The student is acquainted with basic possibilities for the employment of computers in the teaching of mathematics, as well as with the potential and limitations of computer tools.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Every two years, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title	**Abbreviation**
Introduction to Elementary Number Theory (virtual course)	10-M-VHBZth-152-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)**
2	(not) successfully completed	--

Duration	**Module level**	**Other prerequisites**
1 semester	undergraduate	--

Contents

The course gives a brief introduction to mathematical working techniques (propositional logic, sets, definitions, proofs), introduces the different number domains, discusses elementary divisibility properties of the integers (including modular arithmetics) and introduces continued fractions and their approximation properties.

Intended learning outcomes

The students get aquainted with the mathematical language, apply easy deduction techniques to elementary number theoretic questions, and get a first impression of the multifarious applications.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Analytic Geometry (virtual course)			10-M-VHBAnG-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The module gives a brief introduction to the history of geometry, discusses analytic geometry in Euclidean vector spaces (including Hessian normal forms) and finishes with the analysis and classification of quadrics.

Intended learning outcomes

The students gain an overview over the development of geometry and learn to translate geometric problems to the language of linear algebra. They consolidate certain aspects of linear algebra by applying them to geometric questions. Moreover, the course is suitable for preparation for the final state exam.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)

Module title			Abbreviation
Start-up Tutorial Mathematics (virtual course)			10-M-VHBBr-152-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

In-depth discussion of basic topics in mathematics that are well known from school, with a focus on mathematical rigour and proofs.

Intended learning outcomes

The student gets acquainted with the basic working techniques which are prerequisites for the further courses in the teaching degree study programme.

Courses (type, number of weekly contact hours, language — if other than German)

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project (web-based, 15 to 20 hours)
Assessment offered: Every two years, winter semester

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 f)

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Hausarbeit (thesis)

(10 ECTS credits)

Preparation of a written Hausarbeit (thesis) in accordance with the provisions of Section 29 LPO I (examination regulations for teaching-degree programmes) is a prerequisite for teaching degree students to be admitted to the Erste Staatsprüfung (First State Examination). In accordance with the provisions of Section 29 LPO I, students studying for a teaching degree Gymnasium may write this thesis in one of the subjects they selected as vertieft studiertes Fach (subject studied with a focus on the scientific discipline) or in the subject Erziehungswissenschaften (Educational Science). Pursuant to Section 29 Subsection 1 Sentence 2 LPO I, students may also choose to write an interdisciplinary thesis.

Module title			Abbreviation
Thesis in Mathematics (Teaching Degree at German Gymnasium)			10-M-HMGY-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1-2 semester	undergraduate	--	

Contents

Independently researching and writing on a topic in mathematics or mathematics didactics selected in consultation with the supervisor.

Intended learning outcomes

The student is able to work independently on a given mathematical topic and apply the skills and methods obtained during his/her studies in the teaching degree programme. He/She can write down the result of his/her work in a suitable form, incorporating aspects of the didactics of mathematics.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Hausarbeit (thesis) pursuant to Section 29 LPO I (examination regulations for teaching-degree programmes) (250 to 300 hours)
Language of assessment: German; exceptions pursuant to Section 29 Subsection 4 LPO I (examination regulations for teaching-degree programmes)

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 29

Module appears in

First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)