Subdivided 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: 2012
Responsible: Institute of Mathematics
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: $\text{NUM}$ = numerical grade, $B/NB$ = (not) successfully completed

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

Other: $A$ = thesis, $\text{LV}$ = course(s), $\text{PL}$ = assessment(s), $\text{TN}$ = participants, $\text{VL}$ = 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:

$\text{LASPO2009}$

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

$13\text{-Mar-2013 (2012-172)}$

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.
# Module Catalogue for the Subject Mathematics

**LA Gymnasien**

The subject is divided into

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<th>ECTS credits</th>
<th>Method of grading</th>
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<tr>
<td><strong>Scientific Discipline (92 ECTS credits)</strong></td>
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</tr>
<tr>
<td>10-M-AGL-122-m01</td>
<td>Algebra and Geometry for Teaching Degree Mathematics (German Gymnasium)</td>
<td>15</td>
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<td>18</td>
</tr>
<tr>
<td>10-M-ANL-122-m01</td>
<td>Analysis for Teaching Degree Mathematics (German Gymnasium)</td>
<td>18</td>
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<tr>
<td>10-M-ASL-122-m01</td>
<td>Applied Mathematics and Stochastics for Teaching Degree Mathematics (German Gymnasium)</td>
<td>16</td>
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<tr>
<td>10-M-DFL-122-m01</td>
<td>Differential Equations and Complex Analysis for Teaching Degree Mathematics (German Gymnasium)</td>
<td>14</td>
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<td>24</td>
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<tr>
<td>10-M-LNL-122-m01</td>
<td>Linear Algebra for Teaching Degree Mathematics (German Gymnasium)</td>
<td>18</td>
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<tr>
<td>10-M-MDA-122-m01</td>
<td>Introduction into mathematical thinking and working</td>
<td>4</td>
<td>B/NB</td>
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<tr>
<td>10-M-VAL-122-m01</td>
<td>Advanced Analysis for Teaching Degree Mathematics (German Gymnasium)</td>
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<td>10-M-ZTL-122-m01</td>
<td>Introduction into Number Theory for Teaching Degree Mathematics (German Gymnasium)</td>
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<td><strong>Teaching (50 ECTS credits)</strong></td>
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<tr>
<td>10-M-DsGY-122-m01</td>
<td>Didactics of Mathematics: Algebra (German Gymnasium)</td>
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<tr>
<td>10-M-DGYG-122-m01</td>
<td>Didactics of Mathematics: Geometry (German Gymnasium)</td>
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<td>10-M-DGYA-122-m01</td>
<td>Didactics of Mathematics: Analysis (German Gymnasium)</td>
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<tr>
<td><strong>Freier Bereich (general as well as subject-specific electives)</strong></td>
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<td>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 -- interdisciplinarity: The interdisciplinarity additional offer for a teaching degree can be found in the respective Annex &quot;Ergänzende Bestimmungen für den &quot;Freien Bereich&quot; im Rahmen des Studiums für ein Lehramt&quot;.</td>
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<tr>
<td><strong>Mathematics</strong> (Freier Bereich (general as well as subject-specific electives) -- subject specific)</td>
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<tr>
<td>10-M-D3GY-092-m01</td>
<td>Didactics of Mathematics: Analytic Geometry/Stochastics (German Gymnasium)</td>
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<td>10-M-DCMU-092-m01</td>
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<td>Advanced Didactics of Mathematics (German Gymnasium)</td>
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<tr>
<td>10-M-PRM-122-m01</td>
<td>Hands-on Mathematics</td>
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<td>10-M-PRA-122-m01</td>
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<td>10-M-MKG-122-m01</td>
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<td>10-M-SCH-122-m01</td>
<td>School Mathematics from a Higher Perspective</td>
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<td>10-M-SEM-122-m01</td>
<td>Seminar Mathematics</td>
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<tr>
<td>10-M-COM-122-m01</td>
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<tr>
<td>10-M-PRG-122-m01</td>
<td>Programming course for students of Mathematics and other subjects</td>
<td>3</td>
<td>B/NB</td>
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<tr>
<td>10-M-ELG-122-m01</td>
<td>Selected Topics from Mathematics for Teaching Degree Mathematics (German Gymnasium)</td>
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<td>10-M-TuKo-092-m01</td>
<td>Exercise tutor or proof-reading in Mathematics</td>
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<tr>
<td>10-M-DVHVB-092-m01</td>
<td>E-Learning and Blended Learning in Mathematics at school</td>
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<tr>
<td>10-M-VHBMa1-122-m01</td>
<td>Mathematics 1 (virtual course)</td>
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<tr>
<td>10-M-VHBMa2-122-m01</td>
<td>Mathematics 2 (virtual course)</td>
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<td>B/NB</td>
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<tr>
<td>10-M-VHBBBr-122-m01</td>
<td>Start-up Tutorial Mathematics 1 (virtual course)</td>
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<td>10-M-VHBEx-122-m01</td>
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<td>10-M-VHBAri-122-m01</td>
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<td>10-M-VHBGeo-122-m01</td>
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<tr>
<td>10-M-VHBCom-122-m01</td>
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<tr>
<td>10-M-VHBM10-122-m01</td>
<td>Mathematics in Class 10 (virtual course)</td>
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<td>B/NB</td>
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</table>

**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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Module Title</th>
<th>Credits</th>
<th>Type</th>
<th>ECTS</th>
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<tr>
<td>10-M-HMGO-092-m01</td>
<td>Thesis in Mathematics (teaching degree at German Gymnasium)</td>
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<td>NUM</td>
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<td>Module title</td>
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<tr>
<td>Thesis in Mathematics (teaching degree at German Gymnasium)</td>
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<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
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<table>
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<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
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<tr>
<td>10</td>
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<td>Where applicable, specific modules/module components as specified by supervisor.</td>
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<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

**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

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written thesis (approx. 250 to 300 hours total)

Language of assessment: German, exceptions in accordance with Section 29 Subsection 4 LPO I (examination regulations for teaching degree programmes)

**Allocation of places**

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**Additional information**

Additional information on module duration: 1 to 2 semesters.

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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<table>
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<tr>
<th><strong>Module title</strong></th>
<th><strong>Abbreviation</strong></th>
</tr>
</thead>
<tbody>
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<td>Computers in Mathematical Teaching</td>
<td>10-M-DCMU-092-m01</td>
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**Module coordinator**
Dean of Studies Mathematik (Mathematics)

**Module offered by**
Institute of Mathematics

<table>
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<th><strong>ECTS</strong></th>
<th><strong>Method of grading</strong></th>
<th><strong>Only after succ. compl. of module(s)</strong></th>
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</thead>
<tbody>
<tr>
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<td>(not) successfully completed</td>
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</tr>
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</table>

**Duration**
1 semester

**Module level**
undergraduate

**Other prerequisites**
--

**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 (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
project (type and expenditure of time to be specified by the lecturer at the beginning of the course)
Assessment offered: every two years, summer semester

**Allocation of places**
--

**Additional information**
--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)
--
### Module Catalogue for the Subject Mathematics

LA Gymnasien

#### Module title

**Didactics of Mathematics: Analytic Geometry/Stochastics (German Gymnasium)**

#### Abbreviation

10-M-D3GY-092-m01

#### Module coordinator

Dean of Studies Mathematik (Mathematics)

#### Module offered by

Institute of Mathematics

#### ECTS

3

#### Method of grading

(only after successfully completed)

#### Only after successfully completed

--

#### Duration

1 semester

#### Module level

undergraduate

#### Other prerequisites

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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- a) written examination (approx. 60 minutes) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 3, approx. 30 minutes) or d) written elaboration (approx. 5 to 10 pages) or e) project (as specified at the beginning of the course)

Assessment offered: every two years, summer semester

### Allocation of places

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### Additional information

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

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**Module title**
Advanced Didactics of Mathematics (German Gymnasium)

**Abbreviation**
10-M-DVGY-092-m01

**Module coordinator**
Dean of Studies Mathematik (Mathematics)

**Module offered by**
Institute of Mathematics

**ECTS**
2

**Method of grading**
Only after succ. compl. of module(s)

**Duration**
1 semester

**Module level**
undergraduate

**Other prerequisites**
--

**Contents**
Discussion of topics in teaching mathematics in a Gymnasium taking into account different aspects, in particular mathematical foundations, didactic analyses, contemporary discussions in mathematics didactics as well as possible approaches in the classroom.

**Intended learning outcomes**
The student is able to discuss central topics and issues on teaching mathematics in high school (German Gymnasium), considering subject-specific, didactical and methodical aspects.

**Courses**
(type, number of weekly contact hours, language — if other than German)
S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

Talk (approx. 60 minutes)
Assessment offered: once a year, summer semester

**Allocation of places**
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**Additional information**
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**Referred to in LPO I** (examination regulations for teaching-degree programmes)
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Module title: E-Learning and Blended Learning in Mathematics at school
Abbreviation: 10-M-DVHB-092-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)
Module offered by: Institute of Mathematics

ECTS: 3
Method of grading: Only after succ. compl. of module(s)

Duration: 1 semester
Module level: undergraduate

Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew. Courses offered online by Virtuelle Hochschule Bayern (vhb) in the field of mathematics are always incorporated into a module with an exercise. The respective modules can be identified by the word virtuell (online) added in brackets. Registration for the exercise must always be made via SB@Home at the beginning of the course. This registration for the exercise will be considered a declaration of will to seek admission to assessment. If the exercise was successfully completed, the lecturer will put the registration for assessment into effect at the end of the course.

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 mathematics, as well as their potentials and limitations.

Courses (type, number of weekly contact hours, language — if other than German)
Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module title: Exercise tutor or proof-reading in Mathematics

Abbreviation: 10-M-TuKo-092-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)

Module offered by: Institute of Mathematics

ECTS: 5

Method of grading: Only after succ. compl. of module(s)

Duration: 1 semester

Module level: undergraduate

Other prerequisites: Special qualification required; please direct application to teaching coordinator Mathematik (Mathematics), he/she will select participants.

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):

Ä (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus):

Tutoring and correcting activities to be assessed by supervising lecturers or exercise supervisors as specified by supervisors at the beginning of the course.

Allocation of places:

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Additional information:

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

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Module Catalogue for the Subject Mathematics
LA Gymnasien

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<td>10-M-MKG-122-m01</td>
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<td>Institute of Mathematics</td>
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<tr>
<td>2 semester</td>
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<td>By way of exception, additional prerequisites are listed in the section on assessments.</td>
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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)

This module has 4 components; information on courses listed separately for each component.
- 10-M-GES-1-122, 10-M-MSC-1-122, and 10-M-SCH-1-122: V + Ü (no information on language and number of weekly contact hours available)
- 10-M-PRO-1-122: S (no information on language and number of weekly contact hours available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

This module has the following 4 assessment components. To pass the module as a whole students must pass two of the four assessment components.

Assessment in module component 10-M-GES-1-122: Ausgewählte Kapitel aus der Geschichte der Mathematik (Selected Topics from the History of Mathematics), in module component 10-M-MSC-1-122: Mathematisches Schreiben (Mathematical Writing), and in module component 10-M-SCH-1-122: Schulmathematik vom höheren Standpunkt (School Mathematics from a Higher Perspective):
- 4 ECTS credits, pass / fail
- project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)
- Assessment will be offered in the semester in which the course is offered and in the subsequent semester.
- Language of assessment: German; English if agreed upon with examiner(s)
- Additional prerequisites: To qualify for admission to assessment, students must meet certain prerequisites. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-PRO-1-122: Proseminar Mathematik (Proseminar Mathematics)
- 4 ECTS credits, pass / fail
- talk (approx. 60 to 180 minutes)
- Assessment will be offered in the semester in which the course is offered and in the subsequent semester.
- Language of assessment: German; English if agreed upon with examiner(s)
- Additional prerequisites: To qualify for admission to assessment, students must meet certain prerequisites. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the
The lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Allocation of places**

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**Additional information**

Additional information on module duration: 1 to 2 semesters.

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

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**Module title**  
Introduction into mathematical thinking and working

| Abbreviation | 10-M-MDA-122-m01 |

**Module coordinator**  
Dean of Studies Mathematik (Mathematics)

**Module offered by**  
Institute of Mathematics

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<th>ECTS</th>
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<tr>
<td>1 semester</td>
<td>undergraduate</td>
<td>By way of exception, additional prerequisites are listed in the section on assessments.</td>
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</table>

**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**

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- **10-M-MDA-1-122:**  
  - 2 ECTS, Method of grading: (not) successfully completed  
  - project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)  
  - Language of assessment: German, English if agreed upon with the examiner  
  - Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

- **10-M-MDA-2-122:**  
  - 2 ECTS, Method of grading: (not) successfully completed  
  - project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)  
  - Language of assessment: German, English if agreed upon with the examiner  
  - Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-MDA-1-122:**

- Basic Notions and Methods of Mathematical Reasoning

  - 2 ECTS, Method of grading: (not) successfully completed  
  - project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)  
  - Language of assessment: German, English if agreed upon with the examiner  
  - Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-MDA-2-122:**

- Reasoning and Writing in Mathematics

  - 2 ECTS, Method of grading: (not) successfully completed  
  - project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)  
  - Language of assessment: German, English if agreed upon with the examiner  
  - Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
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<th>Additional information</th>
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<th>Referred to in LPO I</th>
<th>(examination regulations for teaching-degree programmes)</th>
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<td>§ 73 (1) 5. Mathematik Angewandte Mathematik</td>
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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

talk (approx. 60 to 180 minutes)
Language of assessment: German, English if agreed upon with the examiner

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<td>Computational Mathematics</td>
<td>10-M-COM-122-m01</td>
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**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 or 10-M-ANL) and 10-M-LNA). 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 + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

project in the form of programming exercises (type and expenditure of time to be specified by the lecturer at the beginning of the course)

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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

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Module title: Programming course for students of Mathematics and other subjects
Abbreviation: 10-M-PRG-122-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)
Module offered by: Institute of Mathematics

ECTS: 3
Method of grading: Only after succ. compl. of module(s)

Duration: 1 semester
Module level: undergraduate
Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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 (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
project in the form of programming exercises (type and expenditure of time to be specified by the lecturer at the beginning of the course)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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<td>Algebra and Geometry for Teaching Degree Mathematics (German Gymnasium)</td>
<td>10-M-AGL-122-m01</td>
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<td>2 semester</td>
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<td>By way of exception, additional prerequisites are listed in the section on assessments.</td>
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</table>

**Contents**

Introduction to algebra and a topic in geometry (differential geometry or projective geometry): basic algebraic structures (groups, rings, fields); axiomatic introduction of projective spaces, coordinates, fundamental theorems, relations to linear algebra and algebra, curves and hypersurfaces in Euclidean spaces, curvature.

**Intended learning outcomes**

The student is acquainted with the fundamental concepts and methods in algebra and a field of 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)

This module has 4 components; information on courses listed separately for each component.
- 10-M-ALG-L-122, 10-M-DGE-L-122, and 10-M-PGE-L-122: V + Ü (no information on language and number of weekly contact hours available)
- 10-M-AGL-P-122: M (no information on language and number of weekly contact hours available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

This module has the following 4 assessment components. To pass the module as a whole students must pass the assessment components 10-M-ALG-L and 10-M-ALG-P and one of the remaining two assessment components.

**Assessment in module component 10-M-ALG-L-122:** Einführung in die Algebra für Lehramt Gymnasium (Introduction to Algebra for Students Pursuing a Teaching Degree Gymnasium), in module component 10-M-DGE-L-122: Einführung in die Differentialgeometrie für Lehramt Gymnasium (Introduction to Differential Geometry for Students Pursuing a Teaching Degree Gymnasium), and in module component 10-M-PGE-L-122: Einführung in die Projektive Geometrie für Lehramt Gymnasium (Introduction to Projective Geometry for Students Pursuing a Teaching Degree Gymnasium):
- 6 ECTS credits, pass / fail
- written examination (approx. 90 to 180 minutes). If announced by the lecturer, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 30 minutes). The module component will also be considered successfully completed if it is selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination is passed.
- Language of assessment: German; English if agreed upon with examiner(s)
- Additional prerequisites: To qualify for admission to assessment, students must meet certain prerequisites. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-AGL-P-122:** Prüfung Algebra und Geometrie für Lehramt Gymnasium (Assessment Algebra and Geometry for Students Pursuing a Teaching Degree Gymnasium)
- 3 ECTS credits, numerical grading
- oral examination of one candidate each (approx. 30 minutes). Assessment will have reference to the topics covered in module 10-M-ALG-L and in the module component selected by students.
- Language of assessment: German; English if agreed upon with examiner(s)
- Only after successful completion of module components: Module component 10-M-AGL-P can only be taken by students who passed the written examination in one of the other three module components.

### Allocation of places

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### Additional information

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

| § 73 (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie |
| § 73 (1) 4. Mathematik Geometrie |
Module title: Analysis for Teaching Degree Mathematics (German Gymnasium)  
Abbreviation: 10-M-ANL-122-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)  
Module offered by: Institute of Mathematics

ECTS: 18  
Method of grading: numerical grade --  
Only after succ. compl. of module(s)

Duration: 2 semester  
Module level: undergraduate  
Other prerequisites: By way of exception, additional prerequisites are listed in the section on assessments.

Contents
Real numbers and completeness, basic topological notions, convergence and divergence of sequences and series, differential and integral calculus in one variable, introduction to differential calculus in several variables.

Intended learning outcomes
The student knows and masters the essential methods and notions of analysis. He/She is able to perform easy mathematical arguments and present them adequately in written and oral form. He/She is acquainted with the central proof methods and concepts in analysis, their analytic background and geometric interpretation.

Courses (type, number of weekly contact hours, language — if other than German)
This module comprises 3 module components. Information on courses will be listed separately for each module component.
- 10-M-ANA-1-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-ANA-2-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-ANL-P-122: M (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 10-M-ANA-1-122: Analysis 1 Analysis 1
- 8 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-ANA-2-122: Analysis 2 Analysis 2
- 8 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: German, English if agreed upon with the examiner
Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-ANL-P-122:** Examination in Analysis for Teaching Degree Mathematics (German Gymnasium)
- 2 ECTS, Method of grading: numerical grade
- Oral examination of one candidate each (approx. 30 minutes); assessment will have reference to the contents of modules 10-M-ANA-1 and 10-M-ANA-2
- Language of assessment: German, English if agreed upon with the examiner

### Allocation of places
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### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
§ 73 (1) 1. Mathematik Analysis
Module title

Applied Mathematics and Stochastics for Teaching Degree Mathematics (German Gymnasium)

Abbreviation

10-M-ASL-122-m01

Module coordinator

Dean of Studies Mathematik (Mathematics)

Module offered by

Institute of Mathematics

ECTS

16

Method of grading

Numerical grade

Only after succ. compl. of module(s)

Duration

2 semester

Module level

Undergraduate

Other prerequisites

By way of exception, additional prerequisites are listed in the section on assessments.

Contents

**Stochastics for teaching degree** (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) and either

**Introduction to Discrete Mathematics** (Techniques from combinatorics, introduction to graph theory including applications, cryptographic methods, error-correcting codes), or

**Numerical Mathematics 1** (Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration), or

**Numerical Mathematics 2** (Solution methods and applications for eigenvalue problems, linear programming, initial value problems for ordinary differential equations, boundary value problems).

Intended learning outcomes

The student is acquainted with the basic concepts and methods in applied mathematics and stochastics, which are required for teaching mathematics in high school (German Gymnasium). He/She is acquainted with the central concepts and algorithms in this field, can apply them independently and knows about the possibilities and limitations of their applicability.

Courses

This module has 5 components; information on courses listed separately for each component.

- **10-M-DIM-L-122, 10-M-NUM1-L-122, 10-M-NUM2-L-122, and 10-M-STO-L-122**: V + Ü (no information on language and number of weekly contact hours available)
- **10-M-ASL-P-122**: M (no information on language and number of weekly contact hours available)

Method of assessment

This module has the following 5 assessment components. To pass this module, students must pass the two assessment components 10-M-ASL-P and 10-M-STO-L and one of the remaining three assessment components.


- 7 ECTS credits (10-M-STO-L-122: 6 ECTS credits), pass / fail

- written examination (approx. 90 to 180 minutes). If announced by the lecturer, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 30 minutes). The module component will also be considered successfully completed if it is selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination is passed.

- Language of assessment: German; English if agreed upon with examiner(s)
Additional prerequisites: To qualify for admission to assessment, students must meet certain prerequisites. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-ASL-P-122: Prüfung Angewandte Mathematik und Stochastik für Lehramt Gymnasium (Assessment Applied Mathematics and Stochastics for Students Pursuing a Teaching Degree Gymnasium)

- 3 ECTS credits, numerical grading
- Oral examination of one candidate each (approx. 30 minutes). Assessment will have reference to the topics covered in module 10-M-STO-L and in the module component selected by students.
- Language of assessment: German; English if agreed upon with examiner(s)
- Only after successful completion of module components: Module component 10-M-ASL-P can only be taken by students who passed the written examination in one of the other four module components.

Allocation of places

Additional information

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

§ 73 (1) 3. Mathematik Stochastik
§ 73 (1) 5. Mathematik Angewandte Mathematik
Module title: Differential Equations and Complex Analysis for Teaching Degree Mathematics (German Gymnasium)

Abbreviation: 10-M-DFL-122-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)

Module offered by: Institute of Mathematics

ECTS: 14

Method of grading: Only after succ. compl. of module(s)

Duration: 2 semester

Module level: undergraduate

Other prerequisites: By way of exception, additional prerequisites are listed in the section on assessments.

Contents:
Existence and uniqueness theorems on solutions of ordinary differential equations, solution theorems on systems of linear differential equations, introduction to the problem of systems of nonlinear differential equations, basic notions in the qualitative theory of ordinary differential equations, basic properties of holomorphic functions, meromorphic functions and conformal maps, basic proof methods in differential equations and complex analysis, applications in computer science, physics, engineering science and other fields of mathematics.

Intended learning outcomes:
The student is acquainted with the fundamental concepts and methods of the theory of ordinary differential equations and holomorphic functions. He/she is able to interconnect these concepts and realises the advantages of thinking across the borders of different branches in mathematics.

Courses:
This module comprises 3 module components. Information on courses will be listed separately for each module component.

- 10-M-DGL-L-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-FTH-L-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-DFL-P-122: M (no information on SWS (weekly contact hours) and course language available)

Method of assessment:
Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 10-M-DGL-L-122: Ordinary Differential Equations for Teaching Degree Mathematics (German Gymnasium)

- 6 ECTS, Method of grading: (not) successfully completed
- Written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-FTH-L-122: Introduction to Complex Analysis for Teaching Degree Mathematics (German Gymnasium)

- 6 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-DFL-P-122: Examination in Differential Equations and Complex Analysis for Teaching Degree Mathematics (German Gymnasium)**

- 2 ECTS, Method of grading: numerical grade
- oral examination of one candidate each (approx. 30 minutes); assessment will have reference to the contents of modules 10-M-DGL-L and 10-M-FTH-L
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of the written examination in any one of the other two module components is a prerequisite for participation in module component 10-M-DFL-P.
Module title: Linear Algebra for Teaching Degree Mathematics (German Gymnasium)
Abbreviation: 10-M-LNL-122-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)
Module offered by: Institute of Mathematics

ECTS: 18
Method of grading: Only after succ. compl. of module(s)

Duration: 2 semester
Module level: undergraduate
Other prerequisites: By way of exception, additional prerequisites are listed in the section on assessments.

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 basic notions and essential methods of linear algebra. He/She is able to perform easy mathematical arguments independently, and can present them adequately in written and oral form. He/She is able to apply the central proof methods and concepts of linear algebra and knows about their algebraic and geometric background.

Courses:
This module comprises 3 module components. Information on courses will be listed separately for each module component.
- 10-M-LNA-1-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-LNA-2-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-LNL-P-122: M (no information on SWS (weekly contact hours) and course language available)

Method of assessment:
Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 10-M-LNA-1-122: Linear Algebra 1
- 8 ECTS, Method of grading: (not) successfully completed
- Written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-LNA-2-122: Linear Algebra 2
- 8 ECTS, Method of grading: (not) successfully completed
- Written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
• Language of assessment: German, English if agreed upon with the examiner
• Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment in module component 10-M-LNL-P-122: Examination in Linear Algebra for Teaching Degree Mathematics (German Gymnasium)

- 2 ECTS, Method of grading: numerical grade
- Oral examination of one candidate each (approx. 30 minutes); assessment will have reference to the contents of modules 10-M-LNA-1 and 10-M-LNA-2
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of the written examination in any one of the other two module components is a prerequisite for participation in module component 10-M-LNL-P.

Allocation of places

Additional information

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

§ 73 (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie
Module title | Abbreviation
--- | ---
Advanced Analysis for Teaching Degree Mathematics (German Gymnasium) | 10-M-VAL-122-m01

Module coordinator | Module offered by
Dean of Studies Mathematik (Mathematics) | Institute of Mathematics

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</table>

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 (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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

§ 73 (1) 1. Mathematik Analysis
<table>
<thead>
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<td>Introduction into Number Theory for Teaching Degree Mathematics (German Gymnasium)</td>
<td>10-M-ZTL-122-m01</td>
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</table>

**Contents**

Elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainder, quadratic forms, diophantine approximation and diophantine equations.

**Intended learning outcomes**

The student is acquainted with the basic concepts of number theory.

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

V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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

§ 73 (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie
Didactics of Mathematics: Algebra (German Gymnasium)  

Abbreviation: 10-M-D1GY-122-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)

Module offered by: Institute of Mathematics

ECTS: 3

Method of grading: Only after succ. compl. of module(s)

Duration: 1 semester

Module level: undergraduate

Other prerequisites:

Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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 and can assess them.

Courses

(V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment:

(a) written examination (approx. 60 to 180 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of up to 3 candidates (groups of 2: approx. 30 minutes, groups of 3: approx. 45 minutes) or d) written elaboration (approx. 5 to 10 pages) or e) project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)

Allocation of places

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Additional information

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

§ 73 (1) 6. Mathematik Didaktik
### Didactics of Mathematics: Geometry (German Gymnasium)

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<td>Didactics of Mathematics: Geometry (German Gymnasium)</td>
<td>10-M-DGYG-122-m01</td>
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</table>

### Contents

Discussion of basic topics in mathematics didactics for Gymnasium using the example of geometry (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 geometry 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 and can assess them.

### Courses

V + Ü (no information on SWS (weekly contact hours) and course language available)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 60 to 180 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of up to 3 candidates (groups of 2: approx. 30 minutes, groups of 3: approx. 45 minutes) or d) written elaboration (approx. 5 to 10 pages) or e) project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)

### Allocation of places

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### Additional information

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

§ 73 (1) 6. Mathematik Didaktik
## Module title

**Didactics of Mathematics: Analysis (German Gymnasium)**

| Abbreviation | 10-M-DGYA-122-m01 |

## Module coordinator

Dean of Studies Mathematik (Mathematics)  
Institute of Mathematics

### ECTS

| Module offered by | LA Gymnasien Mathematics (2012) |

## Duration

1 semester

### Module level

undergraduate

### Other prerequisites

Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### Contents

Discussion of advanced topics in mathematics didactics for Gymnasium using the example of 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 field of analysis in Sekundarstufe II) and is able to take into account the students' perception of mathematical topics, He/She knows different aspects of planning and analysing teaching of mathematics, masters different strategies for teaching and learning and can assess them.

### Courses

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 60 to 180 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of up to 3 candidates (groups of 2: approx. 30 minutes, groups of 3: approx. 45 minutes) or d) written elaboration (approx. 5 to 10 pages) or e) project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course)

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

§ 73 (1) 6. Mathematik Didaktik
### Module title
Hands-on Mathematics

### Abbreviation
10-M-PRM-122-m01

### Module coordinator
Dean of Studies Mathematik (Mathematics)

### Module offered by
Institute of Mathematics

### ECTS
6

### Method of grading
numerical grade

### Only after succ. compl. of module(s)
--

### Duration
2 semester

### Module level
undergraduate

### Other prerequisites
--

### Contents
Elaboration and 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 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. In the practical phase, the students prepare the implementation of the project, implement the project with pupils and afterwards reflect the planning and implementation.

### Intended learning outcomes
The student is able to select a suitable mathematical topic for a school project and elaborate it. He/She is acquainted with different aspects of project planning and management, and can critically reflect the process.

### Courses
P + S (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
project and implementation thereof: drawing up a project plan (approx. 10 pages) and practical implementation with pupils (type and expenditure of time to be specified by the lecturer at the beginning of the course)

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)

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</table>

### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

project: drawing up a project plan (approx. 10 pages)

### Allocation of places

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### Additional information

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

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<table>
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<td>School Mathematics from a Higher Perspective</td>
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</tbody>
</table>

**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 interrelation 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 + Ü | (no information on SWS (weekly contact hours) and course language available) |

**Method of assessment** *(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)*

Project assignments *(type and expenditure of time to be specified by the lecturer at the beginning of the course)*

Assessment offered: in the semester in which the course is offered and in the subsequent semester

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

Additional information on module duration: 1 to 2 semesters.

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

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### Module title
Selected Topics from Mathematics for Teaching Degree Mathematics (German Gymnasium)

### Abbreviation
10-M-ELG-122-m01

### Module coordinator
Dean of Studies Mathematik (Mathematics)

### Module offered by
Institute of Mathematics

### ECTS
8

### Method of grading
Only after succ. compl. of module(s)

### Duration
2 semester

### Module level
undergraduate

### Other prerequisites
By way of exception, additional prerequisites are listed in the section on assessments.

### Contents
An additional lecture in pure or applied mathematics which is not covered in the mandatory courses of the teaching degree programme Gymnasium.

### Intended learning outcomes
The student is acquainted with advanced concepts and methods in pure or applied mathematics. Based on these fundamental mathematical concepts and methods he/she is able to pursue further studies.

### Courses

This module has 3 components; information on courses listed separately for each component.

- **10-M-GAN-1-122: V + Ü** (no information on language and number of weekly contact hours available)
- **10-M-FAN-1-122: V + Ü** (no information on language and number of weekly contact hours available)
- **10-M-ORS-1-122: V + Ü** (no information on language and number of weekly contact hours available)

### Method of assessment

This module has the following 3 assessment components. To pass the module as a whole students must pass one of the three assessment components.

**Assessment component to module component 10-M-GAN-1-122:** Geometrische Analysis

- 8 ECTS credits, method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: English, German if agreed upon with the examiner
- Other prerequisites: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment component to module component 10-M-FAN-1-122:** Einführung in die Funktionalanalysis

- 8 ECTS credits, method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: English, German if agreed upon with the examiner
- Other prerequisites: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
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**Assessment component to module component 10-M-ORS-1-122: Operations Research**
- 8 ECTS credits, method of grading: (not) successfully completed
- written examination (approx. 90 to 180 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes). Module will also be considered successfully completed if the module component was selected as subject of the oral examination covering several modules (separate module component for assessment purposes (Prüfungsteilmodul)) and this examination was passed.
- Language of assessment: English, German if agreed upon with the examiner
- Other prerequisites: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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| Additional information |
| Additional information on module duration: 1 to 2 semesters. |

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**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 (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

**Allocation of places**
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**Additional information**
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**Referred to in LPO I** (examination regulations for teaching-degree programmes)
--
Module title | Abbreviation
---|---
Mathematics 2 (virtual course) | 10-M-VHBMa2-122-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 | Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew. Courses offered online by Virtuelle Hochschule Bayern (vhb) in the field of mathematics are always incorporated into a module with an exercise. The respective modules can be identified by the word virtuell (online) added in brackets. Registration for the exercise must always be made via SB@Home at the beginning of the course. This registration for the exercise will be considered a declaration of will to seek admission to assessment. If the exercise was successfully completed, the lecturer will put the registration for assessment into effect at the end of the course.

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 (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
--
### Module title
Start-up Tutorial Mathematics 1 (virtual course)

### Abbreviation
10-M-VHBBr-122-m01

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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

### Allocation of places
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### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
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### Module Catalogue for the Subject Mathematics

#### LA Gymnasien

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<td>Exam Tutorial Didactics of Mathematics (virtual course)</td>
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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

### Allocation of places

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### Additional information

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

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**Contents**

Basic topics on teaching arithmetics in school, e.g. divisibility 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 (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

**Allocation of places**

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**Additional information**

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

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**Module title** | **Abbreviation**  
--- | ---  
Basics in School Geometry (virtual course) | 10-M-VHBGeo-122-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**  
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1 semester | undergraduate | Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew. Courses offered online by Virtuelle Hochschule Bayern (vhb) in the field of mathematics are always incorporated into a module with an exercise. The respective modules can be identified by the word virtuell (online) added in brackets. Registration for the exercise must always be made via SB@Home at the beginning of the course. This registration for the exercise will be considered a declaration of will to seek admission to assessment. If the exercise was successfully completed, the lecturer will put the registration for assessment into effect at the end of the course.  

**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**  
(U (no information on SWS (weekly contact hours) and course language available)  

**Method of assessment**  
(web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course))  

**Allocation of places**  
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**Additional information**  
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**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 (no information on SWS (weekly contact hours) and course language available)

**Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)**

web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

**Allocation of places**

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**Additional information**

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

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## Module Catalogue for the Subject Mathematics

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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

**Type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus**

web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

### Allocation of places

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### Additional information

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

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### Module title
Mathematics in Class 10 (virtual course)

### Abbreviation
10-M-VHBM10-122-m01

### Module coordinator
Dean of Studies Mathematik (Mathematics)

### Module offered by
Institute of Mathematics

### ECTS
2

### Method of grading
Only after succ. compl. of module(s)

### (not) successfully completed
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### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
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### 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 (no information on SWS (weekly contact hours) and course language available)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
web-based project assignments and tests (length/expenditure of time to be announced at the beginning of the course)

### Allocation of places
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### Additional information
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