# 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"

## Abbreviations used

Course types: $\mathbf{E}=$ field trip, $\mathbf{K}=$ colloquium, $\mathbf{O}=$ conversatorium, $\mathbf{P}=$ placement/lab course, $\mathbf{R}=$ project, $\mathbf{S}=$ seminar, $\mathbf{T}=$ tutorial, $\ddot{\mathbf{U}}=$ exercise, $\mathbf{V}=$ lecture

Term: SS = summer semester, WS = winter semester
Methods of grading: $\mathbf{N U M}=$ numerical grade, $\mathbf{B} / \mathbf{N B}=($ not $)$ successfully completed
Regulations: (L)ASPO = general academic and examination regulations (for teaching-degree programmes), $\mathbf{F S B}=$ subject-specific provisions, $\mathbf{S F B}=$ list of modules

Other: $\mathbf{A}=$ thesis, $\mathbf{L V}=$ course(s), $\mathbf{P L}=$ assessment(s), $\mathbf{T N}=$ participants, $\mathbf{V L}=$ 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:

## LASPO2009

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

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11-Jul-2012 (2012-79)
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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.

## The subject is divided into

| Abbreviation | Module title | ECTS credits | Method of grading | page |
| :---: | :---: | :---: | :---: | :---: |
| Scientific Discipline (92 ECTS credits) |  |  |  |  |
| Compulsory Courses (76 ECTS credits) |  |  |  |  |
| 10-M-PPM-082-mo1 | Propaedeutics of Mathematics | 2 | B/NB | 34 |
| 10-M-GEO-082-mo1 | Introduction to Geometry | 8 | NUM | 16 |
| 10-M-ZAL-o82-mo1 | Number Theory and Algebra | 13 | NUM | 52 |
| 10-M-NM1-082-mo1 | Numerical Mathematics 1 | 8 | NUM | 28 |
| 10-M-LNA-082-mo1 | Linear Algebra | 14 | NUM | 24 |
| 10-M-VKM-082-mo1 | Preparatory Course Mathematics | 1 | B/NB | 51 |
| 10-M-DFT-082-mo1 | Ordinary Differential Equations and Complex Analysis | 13 | NUM | 19 |
| 10-M-ANL-092-mo1 | Analysis for students teaching at a German Gymnasium | 17 | NUM | 5 |
| Compulsory Electives (16 ECTS credits) |  |  |  |  |
| 10-M-BSA-072-mo1 | Seminar in Analysis | 5 | NUM | 37 |
| 10-M-BSL-072-mo1 | Seminar in Linear Algebra | 5 | NUM | 41 |
| 10-M-BSE-072-m01 | Seminar in Algebra | 5 | NUM | 36 |
| 10-M-BSG-072-mo1 | Seminar in Geometry | 5 | NUM | 39 |
| 10-M-BSZ-072-mo1 | Seminar in Number Theory | 5 | NUM | 44 |
| 10-M-BSW-072-mo1 | Seminar in Ordinary Differential Equations | 5 | NUM | 40 |
| 10-M-BSC-072-mo1 | Seminar in Complex Analysis | 5 | NUM | 38 |
| 10-M-BSN-072-mo1 | Seminar in Numerical Mathematics | 5 | NUM | 42 |
| 10-M-BSS-072-mo1 | Seminar in Stochastics | 5 | NUM | 43 |
| 10-M-EDM-072-mo1 | Introduction to Discrete Mathematics | 5 | NUM | 14 |
| 10-M-FAN-072-mo1 | Introduction to Functional Analysis | 5 | NUM | 15 |
| 10-M-ORS-072-mo1 | Operations Research | 5 | NUM | 30 |
| 10-M-NLD-072-mo1 | Non-Linear Dynamics | 5 | NUM | 27 |
| 10-M-COMg-082-mo1 | Computational Mathematics, advanced | 4 | B/NB | 9 |
| 10-M-PRGk-082-mo1 | Programming course for students of Mathematics and other subjects, simple | 2 | B/NB | 32 |
| 10-M-ST1-082-mo1 | Stochastics 1 | 8 | NUM | 45 |
| 10-M-NM2-082-mo1 | Numerical Mathematics 2 | 5 | NUM | 29 |
| 10-M-ST2-082-mo1 | Stochastics 2 | 5 | NUM | 46 |
| 10-M-PRG-082-mo1 | Programming course for students of Mathematics and other subjects | 3 | B/NB | 31 |
| 10-M-COM-082-mo1 | Computeroriented Mathematics | 3 | B/NB | 8 |
| 10-M-VAN-082-mo1 | Advanced Analysis | 8 | NUM | 49 |
| 10-M-STL-092-mo1 | Stochastics for students teaching at a German Gymnasium | 9 | NUM | 47 |
| 10-M-RCL-092-mo1 | Reading Course for students teaching at a German Gymnasium | 2 | B/NB | 35 |
| Teaching (10 ECTS credits) |  |  |  |  |
| 10-M-D1GY-092-mo1 | Didactics of Mathematics: Algebra (German Gymnasium) | 3 | B/NB | 10 |
| 10-M-D2GY-092-mo1 | Didactics of Mathematics: Geometry/Calculus (German Gymnasium) | 7 | NUM | 12 |
| Teaching degree students must take modules worth a total of 15 ECTS credits in the area Freier Bereich (general as well as sub ject-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. |  |  |  |  |
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|Freier Bereich -- interdisciplinary: The interdisciplinary additional offer for a teaching degree can be found in the respective Annex "Ergänzende Bestimmungen für den "Freien Bereich" im Rahmen des Studiums für ein Lehramt".

## Mathematics

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

| $10-M-D C M U-092-m 01$ | Computers in Mathematical Teaching | 3 | $B / N B$ | 7 |
| :--- | :--- | :--- | :--- | :---: |
| $10-M-D 3 G Y-092-m 01$ | Didactics of Mathematics: Analytic Geometry/Stochastics (Ger- <br> man Gymnasium) | 3 | $B / N B$ | 11 |
| $10-M-D V G Y-092-m 01$ | Advanced Didactics of Mathematics (German Gymnasium) | 2 | $B / N B$ | 50 |
| $10-M-P R M-092-m 01$ | Hands-on Mathematics | 8 | NUM | 33 |
| $10-M-D V H B-092-m 01$ | E-Learning and Blended Learning in Mathematics at school | 3 | $B / N B$ | 18 |
| $10-M-$ VHBSto-092-m01 | Stochastics in Sekundarstufe I (virtual course) | 3 | $B / N B$ | 48 |
| $10-M-$ VHBAri-092-m01 | Basics in Arithmetics (virtual course) | 3 | $B / N B$ | 21 |
| $10-M-$ VHBGeo-092-m01 | Basics in School Geometry (virtual course) | 3 | $B / N B$ | 22 |
| $10-M-$ VHBM10-092-m01 | Mathematics in Class 10 (virtual course) | 3 | $B / N B$ | 26 |

## 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.

| $10-M-H M G Y-092-m o 1$ | Thesis in Mathematics (teaching degree at German Gymnasi- <br> um) | 10 | NUM | 23 |
| :--- | :--- | :---: | :---: | :---: |


| Module title |  |  |  |
| :--- | :--- | :--- | :---: |
| Analysis for students teaching at a German Gymnasium |  | Abbreviation |  |
| Module coordinator | Module offered by |  |  |
| Dean of Studies Mathematik (Mathematics) | Institute of Mathematics |  |  |
| ECTS | Method of grading | Only after succ. compl. of module(s) |  |
| 17 | numerical grade | -- |  |
| Duration | Module level | Other prerequisites |  |
| 2 semester | undergraduate | By way of exception, additional prerequisites are listed in the section on <br> assessments. |  |
|  |  |  |  |
| Contents | Real numbers and completeness, basic topological notions, convergence and divergence of sequences and se- <br> ries, power series, Taylor series, fundamental calculus in one and several variables (including inverse and impli- <br> cit function theorem); fundamental integral calculus in one variable (Riemann integral and improper integrals). |  |  |
| Intended learning outcomes |  |  |  |
| The student knows and masters the essential methods and notions of analysis. He/She is able to perform easy <br> mathematical arguments and present them adequately in written and oral form. He/She is acquainted with the <br> central proof methods and concepts in analysis, their analytic background and geometric interpretation. He/She <br> is able to incorporate these concepts in his/her professional teaching. |  |  |  |

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-P-082: M (no information on SWS (weekly contact hours) and course language available)
- 10-M-ANL-1-092: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-ANL-2-092: 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)
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-P-082: Examination in Analysis

- 2 ECTS, Method of grading: numerical grade
- oral examination of one candidate each (approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of any one of the module components $10-$ M-ANA-1, $10-\mathrm{M}-\mathrm{ANL}-1,10-\mathrm{M}-\mathrm{ANA}-2,10-\mathrm{M}-\mathrm{ANL}-2$ is a prerequisite for participation in module component 10-M-ANA-P.
Assessment in module component 10-M-ANL-1-092: Analysis 1 for students teaching at a German Gymnasium Analysis 1 for students teaching at a German Gymnasium
- 6 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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-2-092: Analysis 2 for students teaching at a German Gymnasium Analysis 2 for students teaching at a German Gymnasium

- 9 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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.


## Allocation of places

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Additional information
Referred to in LPO I (examination regulations for teaching-degree programmes)
$\S 73$ (1) 1. Mathematik Analysis

| Module title |  | Abbreviation |
| :--- | :--- | :--- |
| Computers in Mathematical Teaching |  | 10-M-DCMU-o92-mo1 |
| Module coordinator | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) | Only after succ. compl. of module(s) |  |
| ECTS | Method of grading | not) successfully completed |
| 3 | -- | Other prerequisites |
| Duration | Module level | -- |
| 1 semester | undergraduate |  |
| Contents | Discussion of possible ways to use computers in teaching mathematics as well as discussion of common com- <br> puter tools. |  |
| Intended learning outcomes | The student is acquainted with basic possibilities for the employment of computers in the teaching of mathema- <br> tics, 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 seme- <br> ster, 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) <br> Assessment offered: every two years, summer semester <br> Allocation of places <br> -- <br> Additional information <br> -- <br> Referred to in LPO I (examination regulations for teaching-degree programmes) <br> -- |  |  |



| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Computational Mathematics, advanced |  |  |  | 10-M-COMg-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 4 (not | (not) successfully completed | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | Admission prerequisite to assessment: regular attendance of exercises (attendance monitored, a maximum of one incident of unexcused absence). |  |  |
| 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, $10-\mathrm{M}-\mathrm{ANL}$ and $10-\mathrm{M}-\mathrm{LNA}$ ). 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) |  |  |  |  |
| Ü + 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 in the form of programming exercises (type and expenditure of time to be specified by the lecturer at the beginning of the course) <br> Assessment offered: once a year, summer semester <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |  |





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-D2GY-P-092: Didactics of Mathematics: Exam Geometry/Calculus (German Gymnasium)

- 1 ECTS, Method of grading: numerical grade
- written examination (approx. 90 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. 40 minutes)
- Only after successful completion of module components: Successful completion of the module components $10-\mathrm{M}-$ D2GY-1 and $10-\mathrm{M}-$ D2GY-2 is a prerequisite for participation in module component $10-\mathrm{M}-$ D2GY-P.
Assessment in module component 10-M-D2GY-2-092: Didactics of Mathematics: Calculus (German Gymnasium)
Didactics of Mathematics: Calculus (German Gymnasium)
- 2 ECTS, Method of grading: (not) successfully completed
- exercises: At the beginning of the course, the lecturer will specify the type and scope of exercises to be successfully completed over the course of the semester for the module component to be considered successfully completed.
Assessment in module component 10-M-D2GY-1-092: Didactics of Mathematics: Geometry (German Gymnasium) Didactics of Mathematics: Geometry (German Gymnasium)
- 4 ECTS, Method of grading: (not) successfully completed
- exercises: At the beginning of the course, the lecturer will specify the type and scope of exercises to be successfully completed over the course of the semester for the module component to be considered successfully completed.


## 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 |  | Introduction to Functional Analysis | Module offered by |
| :--- | :--- | :--- | :--- |
| Module coordinator | Onlion |  |  |
| Dean of Studies Mathematik (Mathematics) | Institute of Mathematics |  |  |
| ECTS | Method of grading | numerc. compl. of module(s) |  |
| 5 | Other prerequisites |  |  |
| Duration | Module level | Certain prerequisites must be met to qualify for admission to as- <br> sessment. The lecturer will inform students about the respective details <br> at the beginning of the course. Registration for the course will be con- <br> sidered a declaration of will to seek admission to assessment. If stu- <br> dents have obtained the qualification for admission to assessment over <br> the course of the semester, the lecturer will put their registration for as- <br> sessment into effect. Students who meet all prerequisites will be admit- <br> ted to assessment in the current or in the subsequent semester. For as- <br> sessment at a later date, students will have to obtain the qualification for <br> admission to assessment anew. |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Introduction to Geometry |  |  |  | 10-M-GEO-082 |
| Module coordinator |  |  | Module offered b |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 8 num | numerical grade |  |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduat | By way of exception, additional prerequisites are listed in the section on assessments. |  |  |
| Contents |  |  |  |  |
| Introduction to topics in geometry: 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 of geometry. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| This module has 2 components; information on courses listed separately for each component. <br> - 10-M-GEO-1-082: $\mathrm{V}+\mathrm{U}$ (no information on language and number of weekly contact hours available) <br> - 10-M-GEO-2-082: V + Ü (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 2 assessment components. To pass the module as a whole students must pass one of the two assessment components. <br> Assessment component to module component 10-M-GEO-1-082: Einführung in die Projektive Geometrie <br> - 8 ECTS credits, method of grading: numerical grade <br> - written examination (approx. 90 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) <br> - Language of assessment: English, German if agreed upon with the examiner <br> - 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. <br> Assessment component to module component 10-M-GEO-2-082: Einführung in die Differentialgeometrie <br> - 8 ECTS credits, method of grading: numerical grade <br> - written examination (approx. 90 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) <br> - Language of assessment: English, German if agreed upon with the examiner <br> - 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. |  |  |  |  |


| Allocation of places |
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| -- |
| Additional information |
| -- |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |
| $\S 73$ (1) 4. Mathematik Geometrie |



| Module title |  | Abbreviation |
| :--- | :--- | :--- | :--- |
| Ordinary Differential Equations and Complex Analysis |  | $10-M-$ DFT-o82-mo1 |
| Module coordinator | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) | Institute of Mathematics |  |
| ECTS | Method of grading | Only after succ. compl. of module(s) |
| 13 | numerical grade | Other prerequisites |
| Duration | Module level | By way of exception, additional prerequisites are listed in the section on <br> assessments. |
| 2 semester | undergraduate |  |
| Contents | Existence and uniqueness theorems on solutions of ordinary differential equations, solution theorems on sy- <br> stems of linear diffferential equations, introduction to the problem of systems of nonlinear differential equati- <br> ons, basic notions in the qualitative theory of ordinary differential equations, basic properties of holomorphic <br> functions, meromorphic functions and conformal maps, basic proof methods in differential equations and com- <br> plex 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 <br> equations and holomorphic functions. He/she is able to interconnect these concepts and realises the advanta- <br> ges of thinking across the borders of different branches in mathematics. |  |  |

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-DFT-1-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-DFT-2-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-DFT-P-082: 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-DFT-1-082: Ordinary Differential Equations Ordinary Differential Equations

- 4 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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-DFT-2-082: Introduction to Complex Analysis Introduction to Complex Analysis
- 7 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- Language of assessment: German, English if agreed upon with the examiner

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| :--- | :--- | :---: |

- 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-DFT-P-082: Examination in Ordinary Differential Equations and Complex Analysis
- 2 ECTS, Method of grading: numerical grade
- oral examination of one candidate each (approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of module component 10-M-DFT-1 or module component 10-M-DFT-2 is a prerequisite for participation in module component 10-M-DFT-P.


## Allocation of places

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Additional information

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Referred to in LPO I (examination regulations for teaching-degree programmes)
$\S 73$ (1) 1. Mathematik Analysis

| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Basics in Arithmetics (virtual course) |  |  |  | 10-M-VHBAri-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |  |
| 3 (not | (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 |  |  |  |  |
| Basic topics on teaching arithmetics in school, e. g. divisability theory, prime numbers, set theory. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student learns basic topics in the teaching of arithmetics and the related mathematical backgrounds and proofs. He/She is acquainted with the employment of new technologies for teaching arithmetic in school. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| Ü (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 |
| :---: | :---: | :---: | :---: | :---: |
| Thesis in Mathematics (teaching degree at German Gymnasium) |  |  |  | 10-M-HMGY-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 10 num | numerical grade | Where applicable, specific modules/module components as specified by supervisor. |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| Independently researching and writing on a topic in mathematics or mathematics didactics selected in consultation with the supervisor. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is able to work independently on a given mathematical topic and apply the skills and methods obtained during his/her studies in the teaching degree programme. He/She can write down the result of his/her work in a suitable form, incorporating aspects of the didactics of mathematics. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| no courses assigned |  |  |  |  |
| 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) <br> Language of assessment: German, exceptions in accordance with Section 29 Subsection 4 LPO I (examination regulations for teaching degree programmes) |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| Additional information on module duration: 1 to 2 semesters. |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| -- |  |  |  |  |


| Module title |  | Abbreviation |  |
| :--- | :--- | :--- | :--- |
| Linear Algebra | Module offered by |  |  |
| Module coordinator | In-M-LNA-o82-mo1 |  |  |
| Dean of Studies Mathematik (Mathematics) | Only after succ. compl. of module(s) |  |  |
| ECTS | Method of grading | -- | Other prerequisites |
| 14 | numerical grade | By way of exception, additional prerequisites are listed in the section on <br> assessments. |  |
| Duration | Module level | undergraduate |  |
| 2 semester |  |  |  |
| Contents | Sets, relations and maps; notions of groups, rings and fields (in particular, polynomial rings); vector spaces <br> (subspaces, quotient spaces, linear independency, basis, dimension); linear maps (isomorphism theorem, <br> image, kernel, rank); matrix calculus; systems of linear equations, determinants, eigenvalues, eigenvectors and <br> eigenspaces, diagonalisability (including characteristic polynomial, minimal polynomial), normal forms, bilinear <br> forms; Euclidean and unitary vector spaces (orthonormal bases, isometries, principal axis transformation). |  |  |
| Intended learning outcomes |  |  |  |
| The student knows and masters the basic notions and essential methods of linear algebra. He/She is able to <br> perform easy mathematical arguments independently, and can present them adequately in written and oral form. <br> He/She is able to apply the central proof methods and concepts of linear algebra and knows about their alge- <br> braic and geometric background. |  |  |  |

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-LNA-1-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-LNA-2-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-LNA-P-082: 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-LNA-1-082: Linear Algebra 1 Linear Algebra 1

- 7 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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-2-082: Linear Algebra 2 Linear Algebra 2
- 5 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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-P-082: Examination in Linear Algebra
- 2 ECTS, Method of grading: numerical grade
- oral examination of one candidate each (approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of module component 10-M-LNA-1 or module component $10-\mathrm{M}-$ LNA-2 is a prerequisite for participation in module component 10-M-LNA-P.


## Allocation of places

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Additional information

Referred to in LPO I (examination regulations for teaching-degree programmes)
$\S 73$ (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie

| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Mathematics in Class 10 (virtual course) |  |  |  | 10-M-VHBM10-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |  |
| 3 (not | (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 |  |  |  |  |
| 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 |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
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| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Non-Linear Dynamics |  |  |  | 10-M-NLD-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 nu | numerical grade |  |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Basic notions in stability theory, Lyapunov theory; stable manifolds, periodic solutions including Poincare-Bendixson, chaotic dynamics; applications in physics and biology (e. g. Hamiltonian systems, Volterra-Lotka). |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with the fundamental concepts and results in non-linear dynamics and their proof methods. He /She is able to apply these methods to simple situations, e.g. in physics or biology. |  |  |  |  |
| 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 1. Mathematik Analysis |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Numerical Mathematics 1 |  |  |  | 10-M-NM1-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 8 num | numerical grade | -- |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with the fundamental concepts and methods in numerical mathematics, applies them to practical problems and knows about their typical fields of application. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| V + 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Numerical Mathematics 2 |  |  |  | 10-M-NM2-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 num | numerical grade |  |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| 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 able to draw a distinction between the different concepts of numerical mathematics and knows about their advantages and limitations concerning the possibilities of application in different fields of natural and engineering sciences and economics. |  |  |  |  |
| 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |  |



| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Programming course for students of Mathematics and other subjects |  |  |  | 10-M-PRG-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Met | Method of grading | Only after succ. compl. of module(s) |  |  |
| 3 (not) | (not) successfully completed | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | Admission prerequisite to assessment: regular attendance (attendance monitored, a maximum of one incident of unexcused absence). |  |  |
| Contents |  |  |  |  |
| Basics of a modern programming language (e. g. C or Fortran) taking into account the particular needs in mathe matics. |  |  |  |  |
| 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 seme ster, information on whether module can be chosen to earn a bonus) |  |  |  |  |
| project in the form of programming exercises (as specified at the beginning of the course) Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |  |


| Module title |  |  | Abbreviation |
| :---: | :---: | :---: | :---: |
| Programming course for students of Mathematics and other subjects, simple |  |  | 10-M-PRGk-082-mo1 |
| Module coordinator |  |  | Module offered by |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |
| 2 (not | (not) successfully completed | -- |  |
| Duration | Module level | Other prerequisites |  |
| 1 semester | undergraduate | Admission prerequisite to assessment: regular attendance (attendance monitored, a maximum of one incident of unexcused absence). |  |
| Contents |  |  |  |
| Basics of a modern programming language (e. g. C or Fortran) taking into account the particular needs in mathematics. |  |  |  |
| 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |
| Allocation of places |  |  |  |
| -- |  |  |  |
| Additional information |  |  |  |
| -- |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |



| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Propaedeutics of Mathematics |  |  |  | 10-M-PPM-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Met | Method of grading | Only after succ. compl. of module(s) |  |  |
|  | (not) successfully completed |  |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | Admission prerequisite to assessment: regular attendance of courses (as specified at the beginning of the course). |  |  |
| Contents |  |  |  |  |
| Fundamental proof methods and questions in mathematics, insight into examples of abstract concepts of mathematics, e. g. by reference to its historical development, approach to axiomatic and deduction. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with the basic proof methods and techniques in mathematics. He/She is able to perform easy mathematical arguments independently and present them adequately and reasonably in written and oral form. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| $\mathrm{V}+\mathrm{U}$ (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: once a year, winter semester <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| -- |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Reading Course for students teaching at a German Gymnasium |  |  |  | 10-M-RCL-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 2 lnot | (not) successfully completed | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| Independent study of a defined topic in mathematics with the goal of being able to apply the acquired knowledge in the classroom, e. g. in a school project. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is able to work independently on a given scientific topic. He or she can tackle a simple mathematica text and can use standard literature. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| A (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. 30 minutes) or written elaboration (approx. 5 to 10 pages) Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| -- |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Algebra |  |  |  | 10-M-BSE-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in algebra. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| $\S 73$ (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Analysis |  |  |  | 10-M-BSA-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 num | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in analysis. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 1. Mathematik Analysis |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Complex Analysis |  |  |  | 10-M-BSC-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 num | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in complex analysis. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| $\S 73$ (1) 1. Mathematik Analysis |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Geometry |  |  |  | 10-M-BSG-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in geometry or differential geometry. |  |  |  |  |
| 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 active ly 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 minutes) <br> Assessment offered: in the semester in which the course is offered <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 4. Mathematik Geometrie |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Ordinary Differential Equations |  |  |  | 10-M-BSW-072-mo1 |
| Module coordinator |  |  | Modu |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Instit | atics |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 num | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in the theory of ordinary differential equations. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 1. Mathematik Analysis |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Linear Algebra |  |  |  | 10-M-BSL-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in linear algebra. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| $\S 73$ (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Numerical Mathematics |  |  |  | 10-M-BSN-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in numerical 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 5. Mathematik Angewandte Mathematik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Stochastics |  |  |  | 10-M-BSS-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade |  |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in stochastics. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 3. Mathematik Stochastik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Seminar in Number Theory |  |  |  | 10-M-BSZ-072-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Met }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| Contents |  |  |  |  |
| A selected topic in number theory. |  |  |  |  |
| 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 minutes) <br> Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| $\S 73$ (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Stochastics 1 |  |  |  | 10-M-ST1-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {M }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 8 num | numerical grade | -- |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Combinatorics, Laplace models, selected discrete distributions, elementary measure and integration theory, continuous distributions: normal distribution, random variable, distribution function, product measures and stochastic independence, elementary conditional probability, characteristics of distributions: expected value and variance, limit theorems: law of large numbers, central limit theorem. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with fundamental concepts and methods in stochastics, applies these methods to practical problems and knows about the typical fields of application. |  |  |  |  |
| 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 3. Mathematik Stochastik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Stochastics 2 |  |  |  | 10-M-ST2-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {P }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 5 | numerical grade |  |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Elements of data analysis, statistics of data in normal and other distributions, elements of multivariate statistics. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with fundamental concepts and methods in statistics, applies these methods to practical problems and knows about the typical fields of application. |  |  |  |  |
| 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 3. Mathematik Stochastik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Stochastics for students teaching at a German Gymnasium |  |  |  | 10-M-STL-092 |
| Module coordinator |  |  |  |  |
| Dean of Studies Mathematik (Mathematics) |  |  |  | atics |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |  |
| 9 num | numerical grade |  |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Discrete statistics, in particular stochastic modelling, motivation of conceptualisation and discussion of basic assumptions: basic notions of descriptive statistics, discrete probability spaces, random variables, important discrete distributions, elements of combinatorics, principle of inclusion and exclusion, multistage experiments, conditional probability, stochastic independence, common distributions, expected value and variance, covariance and correlation, waiting time problems, law of the large numbers, central limit theorem, confidence intervals and statistical tests in binomial models, stochastic paradoxes. |  |  |  |  |
| Intended learning outcomes |  |  |  |  |
| The student is acquainted with fundamental concepts and methods of stochastics, as required for teaching at German Gymnasium. He/She is able to assess stochastic phenomena correctly and handle the concept of statistical significance. |  |  |  |  |
| Courses (type, number of weekly contact hours, language - if other than German) |  |  |  |  |
| V + 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 3. Mathematik Stochastik |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Stochastics in Sekundarstufe I (virtual course) |  |  |  | 10-M-VHBSto-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS ${ }^{\text {Me }}$ | Method of grading | Only after succ. compl. of module(s) |  |  |
| 3 (not | (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 |  |  |  |  |
| 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 |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| -- |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Advanced Analysis |  |  |  | 10-M-VAN-082-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |  |
| 8 nu | numerical grade |  |  |  |
| 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. |  |  |
| Contents |  |  |  |  |
| Lebesgue integral in several variables, including theorems on convergence and Fubini's theorem, $L^{\wedge} p$-spaces and elementary Fourier theory in $\mathrm{L}^{\wedge}$, Gauss's theorem. |  |  |  |  |
| 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) |  |  |  |  |
| Ü + 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) |  |  |  |  |
| written examination (approx. 90 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) <br> Language of assessment: German, English if agreed upon with the examiner |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
| § 73 (1) 1. Mathematik Analysis |  |  |  |  |


| Module title |  |  |  | Abbreviation |
| :---: | :---: | :---: | :---: | :---: |
| Advanced Didactics of Mathematics (German Gymnasium) |  |  |  | 10-M-DVGY-092-mo1 |
| Module coordinator |  |  | Module offered by |  |
| Dean of Studies Mathematik (Mathematics) |  |  | Institute of Mathematics |  |
| ECTS Me | Method of grading | Only after succ. compl. of module(s) |  |  |
| 2 (not | (not) successfully completed | -- |  |  |
| Duration | Module level | Other prerequisites |  |  |
| 1 semester | undergraduate | -- |  |  |
| 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) <br> Assessment offered: once a year, summer semester |  |  |  |  |
| Allocation of places |  |  |  |  |
| -- |  |  |  |  |
| Additional information |  |  |  |  |
| -- |  |  |  |  |
| Referred to in LPO I (examination regulations for teaching-degree programmes) |  |  |  |  |
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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-ZAL-1-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-ZAL-2-082: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-ZAL-P-082: 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-ZAL-1-082: Introduction to Number Theory Introduction to Number Theory

- 4 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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-ZAL-2-082: Introduction to Algebra Introduction to Algebra
- 7 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 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)
- 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

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| :--- | :--- | :---: |

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-ZAL-P-082: Examination in Number Theory and Algebra

- 2 ECTS, Method of grading: numerical grade
- oral examination of one candidate each (approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Only after successful completion of module components: Successful completion of module component $10-\mathrm{M}-\mathrm{ZAL}-1$ or module component $10-\mathrm{M}-\mathrm{ZAL}-2$ is a prerequisite for participation in module component $10-$ M-ZAL-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

