Module Catalogue
for the Subject
Mathematics International
as a Master’s with 1 major
with the degree "Master of Science"
(120 ECTS credits)

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

The subject is divided into

**Learning Outcomes**

**Abbreviations used, Conventions, Notes, In accordance with**

**Compulsory Electives**

### Mathematics

- Applied Analysis
- Topics in Algebra
- Differential Geometry
- Complex Analysis
- Geometric Structures
- Industrial Statistics 1
- Lie Theory
- Numeric of Large Systems of Equations
- Basics in Optimization
- Control Theory
- Stochastic Models of Risk Management
- Stochastical Processes
- Topology
- Insurance Mathematics 1
- Time Series Analysis 1
- Number Theory
- Giovanni Prodi Lecture (Master)
- Selected Topics in Analysis
- Algebraic Topology
- Selected Topics in Financial Mathematics
- Groups and their Representations
- Geometrical Mechanics
- Industrial Statistics 2
- Field Arithmetics
- Numeric of Partial Differential Equations
- Selected Topics in Optimization
- Statistical Analysis
- Insurance Mathematics 2
- Time Series Analysis 2
- Discrete Mathematics
- Dynamical Systems
- Aspects of Geometry
- Mathematical Continuum Mechanics
- Mathematical Imaging
- Selected Topics in Mathematical Physics
- Selected Topics in Control Theory
- Inverse Problems
- Module Theory
- Non-linear Analysis
- Optimal Control
- Networked Systems
- Complex Geometry
- Partial Differential Equations of Mathematical Physics
- Pseudo Riemannian and Riemannian Geometry
- Functional Analysis
- Applied Differential Geometry
- Giovanni Prodi Lecture Selected Topics (Master)
- Giovanni Prodi Lecture Advanced Topics (Master)
### Module Catalogue for the Subject Mathematics International

**Master's with 1 major, 120 ECTS credits**

<table>
<thead>
<tr>
<th>Module</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giovanni Prodi Lecture Modern Topics (Master)</td>
<td>60</td>
</tr>
<tr>
<td><strong>Research in Groups and Seminars</strong></td>
<td>62</td>
</tr>
<tr>
<td>Research in Groups - Algebra</td>
<td>63</td>
</tr>
<tr>
<td>Research in Groups - Discrete Mathematics</td>
<td>64</td>
</tr>
<tr>
<td>Research in Groups - Dynamical Systems and Control Theory</td>
<td>65</td>
</tr>
<tr>
<td>Research in Groups - Complex Analysis</td>
<td>66</td>
</tr>
<tr>
<td>Research in Groups - Geometry and Topology</td>
<td>67</td>
</tr>
<tr>
<td>Research in Groups - Mathematics in Context</td>
<td>68</td>
</tr>
<tr>
<td>Research in Groups - Mathematics in the Sciences</td>
<td>69</td>
</tr>
<tr>
<td>Research in Groups - Measure and Integral</td>
<td>70</td>
</tr>
<tr>
<td>Research in Groups - Numerical Mathematics and Applied Analysis</td>
<td>71</td>
</tr>
<tr>
<td>Research in Groups - Robotics, Optimization and Control Theory</td>
<td>72</td>
</tr>
<tr>
<td>Research in Groups - Time Series Analysis</td>
<td>73</td>
</tr>
<tr>
<td>Research in Groups - Statistics</td>
<td>74</td>
</tr>
<tr>
<td>Research in Groups - Number Theory</td>
<td>75</td>
</tr>
<tr>
<td>Research in Groups - Control Theory of Quantum Mechanical Systems</td>
<td>76</td>
</tr>
<tr>
<td>Research in Groups - Differential Geometry</td>
<td>77</td>
</tr>
<tr>
<td>Research in Groups - Deformation Quantization</td>
<td>78</td>
</tr>
<tr>
<td>Research in Groups - Non-linear Analysis</td>
<td>79</td>
</tr>
<tr>
<td>Research in Groups - Operator Algebras</td>
<td>80</td>
</tr>
<tr>
<td>Seminar in Applied Differential Geometry</td>
<td>81</td>
</tr>
<tr>
<td>Seminar in Algebra</td>
<td>82</td>
</tr>
<tr>
<td>Seminar in Dynamical Systems and Control</td>
<td>83</td>
</tr>
<tr>
<td>Seminar in Complex Analysis</td>
<td>84</td>
</tr>
<tr>
<td>Seminar in Financial and Insurance Mathematics</td>
<td>85</td>
</tr>
<tr>
<td>Seminar in Geometry and Topology</td>
<td>86</td>
</tr>
<tr>
<td>Giovanni Prodi Seminar (Master)</td>
<td>87</td>
</tr>
<tr>
<td>Interdisciplinary Seminar</td>
<td>89</td>
</tr>
<tr>
<td>Seminar Mathematics in the Sciences</td>
<td>90</td>
</tr>
<tr>
<td>Seminar in Numerical Mathematics and Applied Analysis</td>
<td>91</td>
</tr>
<tr>
<td>Seminar in Optimization</td>
<td>92</td>
</tr>
<tr>
<td>Seminar in Statistics</td>
<td>93</td>
</tr>
<tr>
<td>Seminar in Non-linear Analysis</td>
<td>94</td>
</tr>
<tr>
<td><strong>Thesis</strong></td>
<td>95</td>
</tr>
<tr>
<td>Master Thesis Mathematics International</td>
<td>96</td>
</tr>
</tbody>
</table>
The subject is divided into

<table>
<thead>
<tr>
<th>section / sub-section</th>
<th>ECTS credits</th>
<th>starting page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compulsory Electives</td>
<td>90</td>
<td>7</td>
</tr>
<tr>
<td>Mathematics</td>
<td>30-70</td>
<td>8</td>
</tr>
<tr>
<td>Research in Groups and Seminars</td>
<td>20-60</td>
<td>62</td>
</tr>
<tr>
<td>Thesis</td>
<td>30</td>
<td>95</td>
</tr>
</tbody>
</table>
Learning Outcomes

Scientific qualification

• Graduates are trained in analytical thinking, possess a highly developed capacity for abstraction, universally applicable problem-solving skills and the ability to structure complex relationships.
• Graduates are able to independently familiarise themselves with current research areas in mathematics using specialised literature.
• Graduates are able to present their knowledge, ideas and solutions to complex issues in English to an international audience of experts in a comprehensible way.
• Graduates possess the specialised knowledge, thought processes and methodological skills required for independent scientific work, in particular for doctoral studies.
• Graduates know the rules of good scientific practice and are able to observe them in extensive work.
• Graduates have advanced knowledge of current areas of mathematics and are able to confidently use advanced methods in these areas.
• Graduates have in-depth knowledge and an overview of a current research topic from at least one area of mathematics.

Ability to take up employment

• Graduates are trained in analytical thinking, possess a highly developed capacity for abstraction, universally applicable problem-solving skills and the ability to structure complex relationships.
• Graduates are able to formulate and present their knowledge, ideas and problem solutions in English in a way that is understandable to the target audience.
• Graduates are able to recognise, structure and model complex problems from other fields (such as the natural sciences, engineering or economics), develop solutions using mathematical methods and interpret and evaluate these results.
• The graduates have resilience in solving complex problems.
• The graduates are able to work constructively and oriented towards a goal in international teams and are able to take responsibility for a wide range of tasks.
• Graduates are able to develop new fields of knowledge independently, efficiently and systematically.

Personal development

• Graduates are trained in analytical thinking, possess a highly developed capacity for abstraction, universally applicable problem-solving skills and the ability to structure complex relationships.
• Graduates can play a constructive role in participatory processes.
• The graduates have resilience in solving complex problems.
• Graduates are able to formulate complex ideas and proposed solutions in a generally understandable way and present them professionally.
• Graduates possess intercultural skills and can communicate and act in an international environment.
**Abbreviations used**

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

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

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

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

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

**Conventions**

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

**Notes**

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

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

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

**In accordance with**

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

**ASPO2015**

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

**13-Jul-2015 (2015-17)**

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.
Compulsory Electives

(90 ECTS credits)
Mathematics

(30-70 ECTS credits)
### Module title
**Applied Analysis**

### Abbreviation
10-M-AAAIn-152-m01

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

### Module offered by
Institute of Mathematics

### ECTS
10

### Method of grading
Numerical grade

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

### Duration
1 semester

### Module level
Graduate

### Other prerequisites
--

### Contents

### Intended learning outcomes
The student is acquainted with the fundamental notions, methods and results of higher analysis. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics and other natural and engineering sciences.

### Courses
**Type, number of weekly contact hours, language — if other than German**

| V (4) + Ü (2) |

Module taught in: English

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

- a) written examination (approx. 90 to 120 minutes, usually chosen) or
- b) oral examination of one candidate each (approx. 20 minutes) or
- c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

Creditable for bonus: --

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

### Referred to in LPO 1 (examination regulations for teaching-degree programmes)
--

### Module appears in
- Master’s degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Physics International (2020)
- Master’s degree (1 major) Mathematics International (2021)
- Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topics in Algebra</td>
<td>10-M=AALGin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Contemporary topics in algebra, for example coding theory, elliptic curves, algebraic combinatorics or computer algebra.

**Intended learning outcomes**

The student is acquainted with fundamental concepts and methods in a contemporary field of algebra, and is able to apply these skills to complex questions.

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

- V (4) + Ü (2)

Module taught in: English

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

- a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential Geometry</td>
<td>10-M=ADGMin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Central and advanced results in differential geometry, in particular about differentiable and Riemannian manifolds.

**Intended learning outcomes**

The student is acquainted with concepts and methods for differentiable manifolds or Riemannian manifolds, is able to apply these methods and knows about the interaction of local and global methods in differential geometry.

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

V (4) + Ü (2)
Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Physics International (2020)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Analysis</td>
<td>10-M=AFTHin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

In-depth study of mapping properties of analytic functions and their generalisations with modern analytic and geometric methods. Structural properties of families of holomorphic and meromorphic functions. Special functions (e.g. elliptic functions).

**Intended learning outcomes**

The student is acquainted with the fundamental notions, methods and results of higher complex analysis, in particular the (geometric) mapping properties of holomorphic functions. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English
creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Physics International (2020)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
## Module title
Geometric Structures

## Abbreviation
10-M=AGMSin-152-m01

## Module coordinator
Dean of Studies Mathematik (Mathematics)

## Module offered by
Institute of Mathematics

## ECTS
10

## Method of grading
numerical grade

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

## Duration
1 semester

## Module level
graduate

## Other prerequisites
--

### Contents
Tits buildings, generalised polygons or related geometric structures, automorphisms, BN pairs in groups, Moufang conditions, classification results.

### Intended learning outcomes
The student is acquainted with the fundamental notions, methods and results concerning a type of geometric structure. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

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

- V (4) + Ü (2)

Module taught in: English

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

- a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

### Module appears in
- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Statistics 1</td>
<td>10-M=AISTin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Theory of parameter and domain estimates, tests for statistical estimates, distribution models, empirical distribution analysis, comparative analysis, statistical product testing, survey sampling, audit sampling.

**Intended learning outcomes**

The student masters the fundamental statistical methods for industrial applications.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lie Theory</td>
<td>10-M=ALTHin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

Linear Lie groups and their Lie algebras, exponential function, structure and classification of Lie algebras, classic examples, applications, e.g. in physics and control theory.

### Intended learning outcomes

The student is acquainted with the fundamental results, theorems and methods in Lie theory. He/She is able to apply these to common problems, and knows about the interactions of group theory, analysis, topology and linear algebra.

### Courses

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

V (4) + Ü (2)

Module taught in: English

### Method of assessment

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--

### Module appears in

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Physics International (2020)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
Module title | Abbreviation
--- | ---
Numeric of Large Systems of Equations | 10-M=ANGGin-152-m01

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

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

Duration | Module level | Other prerequisites
--- | --- | ---
1 semester | graduate | --

Contents
Discretisation of elliptic differential equations, classical iteration methods, preconditioners, multigrid methods.

Intended learning outcomes
The student is acquainted with the most important methods for solving large systems of equations, and knows the most efficient way to solve a given system of equations.

Courses (type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

Allocation of places
--

Additional information
--

Workload
300 h

Teaching cycle
--

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

Module appears in
Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basics in Optimization</td>
<td>10-M=AOPTin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**Contents**
Fundamental methods and techniques in continuous optimization, unrestricted optimization, conditions for optimality, restricted optimization, examples and applications in natural and engineering sciences as well as economics.

**Intended learning outcomes**
The student knows the fundamental methods of continuous optimization, can judge their strengths and weaknesses and can decide which method is the most suitable in applications.

**Courses**
(type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)
Module taught in: English

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Theory</td>
<td>10-M=ARTH-in-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

Introduction to mathematical systems theory: stability, controllability and observability, state feedback and stability, basics in optimal control.

### Intended learning outcomes

The student is acquainted with the fundamental notions and methods of control theory. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

### Courses

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

V (4) + Ü (2)  
Module taught in: English

### Method of assessment

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)  
Assessment offered: In the semester in which the course is offered and in the subsequent semester  
Language of assessment: English  
Creditable for bonus

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

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

--

### Module appears in

- Master’s degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Mathematics International (2021)
- Master’s degree (1 major) Mathematics International (2022)
### Module title

**Stochastic Models of Risk Management**

### Abbreviation

10-M=ASMRin-152-m01

### Module coordinator

Dean of Studies Mathematik (Mathematics)

### Module offered by

Institute of Mathematics

### ECTS

10

### Method of grading

numerical grade

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

--

### Duration

1 semester

### Module level

graduate

### Other prerequisites

--

### Contents

Measure theory, risk diagrams, failure mode and effects analysis, risk assessment in auditing, shortfall measures, value at risk, conditional value at risk, axiomatic of risk measures, modelling of interdependencies, copula, modelling of functional interrelations, regression models, basics in time series modelling, aggregated losses, estimates of shortfall measures, estimates of value at risk and conditional value at risk, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, estimates of value at risk in time series, elementary empirical regression analysis, simulation methods.

### Intended learning outcomes

The student is acquainted with the fundamental methods of stochastic risk analysis.

### Courses

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>4</td>
<td>English</td>
</tr>
<tr>
<td>Ü</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Module taught in: English

### Method of assessment

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

### Referred to in LPO I

(Examination regulations for teaching-degree programmes)

--

### Module appears in

Master's degree (1 major) Mathematics International (2015)

Master's degree (1 major) Mathematics International (2021)

Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stochastical Processes</td>
<td>10-M=ASTPin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markov chains, queues, stochastic processes in $\mathbb{C}[0,1]$, Brownian motion, Donsker's theorem, projective limits.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intended learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student is acquainted with the fundamental notions and methods of stochastical processes and can apply them to practical problems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Courses (type, number of weekly contact hours, language — if other than German)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (4) + Ü (2) Module taught in: English</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the semester in which the course is offered and in the subsequent semester</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Language of assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allocation of places</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Referred to in LPO I (examination regulations for teaching-degree programmes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module appears in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master's degree (1 major) Mathematics International (2015)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics International (2021)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics International (2022)</td>
</tr>
<tr>
<td>Module title</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Topology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Set-theoretic topology, topological invariants (e.g. fundamental group, connection), construction of topological spaces, covering spaces.

**Intended learning outcomes**
The student is acquainted with the fundamental results, theorems and methods in topology and is able to apply these to common problems.

**Courses** (type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)
Module taught in: English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Physics International (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance Mathematics 1</td>
<td>10-M=AVSMin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

The module discusses policies on one life: distributions of future lifetime, life tables, life table approximations, types of benefits, present value, expection principle, premium calculation, commutation functions, reserves and policy values, expenses, bonus, recursive methods, Thiele's differential equation.

### Intended learning outcomes

The student is acquainted with the fundamental notions and methods of life insurance mathematics and can apply them to practical problems.

### Courses

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

V (4) + Ü (2)
Module taught in: English

### Method of assessment

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
credible for bonus

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--

### Module appears in

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Series Analysis 1</td>
<td>10-M-AZRAIn-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Additive model, linear filters, autocorrelation, moving average, autoregressive processes, Box-Jenkins method.

**Intended learning outcomes**

The student is acquainted with the fundamental methods of time series analysis and can apply them to practical problems.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master's degree (1 major) Mathematics International (2021)
Module title
Number Theory

Abbreviation
10-M=AZThin-152-m01

Module coordinator
Dean of Studies Mathematik (Mathematics)

Module offered by
Institute of Mathematics

ECTS
10

Method of grading
numerical grade

Duration
1 semester

Module level
graduate

Other prerequisites
--

Contents
Number-theoretic functions and their associated Dirichlet series resp. Euler products, their analytic theory with applications to prime number distribution and diophantine equations; discussion of the Riemann hypothesis, overview of the development of modern number theory.

Intended learning outcomes
The student is acquainted with the fundamental methods of analytic number theory, can deal with algebraic structures in number theory and knows methods for the solution of diophantine equations. He/She has insight into modern developments in number theory.

Courses
V (4) + Ü (2)

Module taught in: English

Method of assessment
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

Allocation of places
--

Additional information
--

Workload
300 h

Teaching cycle
--

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

Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Physics International (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module Catalogue for the Subject
Mathematics International
Master’s with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giovanni Prodi Lecture (Master)</td>
<td>10-M=AGPCin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
Introduction to a specialised topic in mathematics by an international expert.

### Intended learning outcomes
The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (3) + Ü (1)
Module taught in: English

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

- a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload

150 h

### Teaching cycle

--

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

--

### Module appears in

- Master’s degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Mathematics (2016)
- Master’s degree (1 major) Mathematical Physics (2016)
- Master’s degree (1 major) Computational Mathematics (2016)
- Master’s degree (1 major) Computational Mathematics (2019)
- Master’s degree (1 major) Mathematics (2019)
- Master’s degree (1 major) Mathematical Physics (2020)
- Master’s degree (1 major) Mathematics International (2021)
- Master’s degree (1 major) Computational Mathematics (2022)
- Master’s degree (1 major) Mathematics (2022)
- Master’s degree (1 major) Mathematical Physics (2022)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Topics in Analysis</td>
<td>10-M=VANAin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
In-depth discussion of a specialised topic in analysis taking into account recent developments and interrelations with other mathematical concepts.

**Intended learning outcomes**
The student is acquainted with advanced results in a selected topic in analysis, and is able to apply these to complex problems.

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

V (4) + Ü (2)
Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebraic Topology</td>
<td>10-M=VATPin-152-m01</td>
</tr>
</tbody>
</table>

**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Homology, homotopy invariance, exact sequences, cohomology, application to the topology of Euclidean spaces.

**Intended learning outcomes**

The student is acquainted with advanced results in algebraic topology.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
exchange program Mathematics (2023)
### Module title
Selected Topics in Financial Mathematics

### Abbreviation
10-M=VFNMIn-152-m01

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

### Module offered by
Institute of Mathematics

### ECTS
| 10 |

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
Selected topics in financial mathematics, e.g. conditional expectation and martingales, fundamental theorem of asset pricing in discrete time for finite spaces, American put, Snell envelope, stopping time, optimal stopping, stochastic integration, stochastic differential equations and Ito calculus, Black-Merton-Scholes model.

### Intended learning outcomes
The student is acquainted with advanced results in financial mathematics. He/She gains the ability to work on contemporary research questions in financial mathematics and can apply his/her skills to complex problems.

### Courses
(type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)
Module taught in: English

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

### Referred to in LPO 1
(examination regulations for teaching-degree programmes)
--

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups and their Representations</td>
<td>10-M=VGDSin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Finite permutation groups and character theory of finite groups, interrelations and special techniques such as the S-rings of Schur.

**Intended learning outcomes**

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in group theory and representation theory and can apply his/her skills to complex problems.

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

- V (4) + Ü (2)
  - Module taught in: English

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

- a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
- Assessment offered: In the semester in which the course is offered and in the subsequent semester
- Language of assessment: English
- creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

- 300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Physics International (2020)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
## Geometrical Mechanics

**Module title**: Geometrical Mechanics  
**Abbreviation**: 10-M=VGEMin-152-m01

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

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

**Duration**: 1 semester  
**Module level**: Graduate  
**Other prerequisites**: --

### Contents

The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: symplectic geometry, cotangent bundles and other examples of symplectic manifolds, symmetries and Noether theorem, phase space reduction, normal forms, introduction to Poisson geometry.

### Intended learning outcomes

The student is acquainted with selected advanced applications of differential geometry to geometric mechanics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

### Courses

<table>
<thead>
<tr>
<th>(type, number of weekly contact hours, language — if other than German)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (4) + Ü (2) English</td>
</tr>
</tbody>
</table>

**Module taught in**: English

### Method of assessment

- a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester  
Language of assessment: English  
credible for bonus

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

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

--

### Module appears in

- Master’s degree (1 major) Mathematics International (2015)  
- Master’s degree (1 major) Physics International (2020)  
- Master’s degree (1 major) Mathematics International (2021)  
- Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Statistics 2</td>
<td>10-M=VISTin-152-m01</td>
</tr>
</tbody>
</table>

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

### Module offered by
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
Linear models, regression analysis, nonlinear regression, experimental design, basics in time series modeling, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, statistical process monitoring.

### Intended learning outcomes
The student masters advanced statistical methods for industrial applications.

### Courses
(V (4) + Ü (2)
Module taught in: English

### Method of assessment
(a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

### Module appears in
- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Arithmetics</td>
<td>10-M=VKARIn-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Combination of Galois theory, group theory and the theory of function fields with the aim of application in number theory, e.g. topics around Hilbert's irreducibility theorem, permutation polynomials (e.g. Calitz-Wan-conjecture) and the inverse problem in Galois theory.

**Intended learning outcomes**

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in algebra and can apply his/her skills to complex problems.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester Language of assessment: English creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module Catalogue for the Subject
### Mathematics International
### Master's with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeric of Partial Differential Equations</td>
<td>10-M=VNPEin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Types of partial differential equations, qualitative properties, finite differences, finite elements, error estimates (numerical methods for elliptic, parabolic and hyperbolic partial differential equations; finite elements method, discontinuous Gelerkin finite elements method, finite differences and finite volume methods).

**Intended learning outcomes**

The student is acquainted with advanced methods for discretising partial differential equations.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Physics International (2020)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Topics in Optimization</td>
<td>10-M=VOPTin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected topics in optimization, e. g. inner point methods, semidefinite programs, non-smooth optimization, game theory, optimization with differential equations.

**Intended learning outcomes**

The student is acquainted with advanced methods in continuous optimization. He gains the ability to work on contemporary research questions in continuous optimization.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master’s degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Mathematics International (2021)
- Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical Analysis</td>
<td>10-M=VSTAIN-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Contingency tables, categorical regression, one-factorial variance analysis, two-factorial variance analysis, discriminant function analysis, cluster analysis, principal component analysis, factor analysis.

**Intended learning outcomes**

The student is acquainted with the fundamental methods in statistical analysis and can apply them to practical problems.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master’s degree (1 major) Mathematics International (2021)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance Mathematics 2</td>
<td>10-M=VVSMin-152-m01</td>
</tr>
</tbody>
</table>

**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

**ECTS** | **Method of grading** | **Only after succ. compl. of module(s)**
--- | --- | ---
10 | numerical grade | --

**Duration** | **Module level** | **Other prerequisites**
--- | --- | ---
1 semester | graduate | --

**Contents**

This module discusses modern valuation approaches and multiple decrement models regarding one life or two lives: modern valuation in life insurance mathematics, axiomatic derivation of the product measure approach, Markov chain models, Kolmogorov's differential equations, Thiele's differential equations, numerical applications, joint life policies.

**Intended learning outcomes**

The student is acquainted with advanced methods in insurance mathematics. He gains the ability to work on contemporary research questions in insurance mathematics and can apply his/her skills to complex problems.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Series Analysis 2</td>
<td>10-M=VZRAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
State-space models, Kalman filter, frequency spaces, Fourier analysis, periodograms, characterisation of autocovariance functions.

### Intended learning outcomes
The student is acquainted with advanced methods in time series analysis. He gains the ability to work on contemporary research questions in this field.

<table>
<thead>
<tr>
<th>Courses (type, number of weekly contact hours, language — if other than German)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (4) + Ü (2)</td>
</tr>
</tbody>
</table>

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Module title | Abbreviation
--- | ---
Discrete Mathematics | 10-M=VDIMin-152-m01

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

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

Duration | Module level | Other prerequisites
--- | --- | ---
1 semester | graduate | --

Contents
Advanced methods and results in a selected field of discrete mathematics (e.g. coding theory, cryptography, graph theory or combinatorics)

Intended learning outcomes
The student is acquainted with advanced results in a selected topic in discrete mathematics.

Courses (type, number of weekly contact hours, language — if other than German)
V (3) + Ü (1)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
credible for bonus

Allocation of places
--

Additional information
--

Workload
150 h

Teaching cycle
--

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

Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Physics International (2020)
Master's degree (1 major) Quantum Engineering (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamical Systems</td>
<td>10-M=VDSYin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

- **Contents**
  Fundamentals of dynamical systems, e.g. stability theory, ergodic theory, Hamiltonian systems.

- **Intended learning outcomes**
  The student masters the mathematical methods in the theory of dynamic systems, and is able to analyse their quality.

- **Courses** (type, number of weekly contact hours, language — if other than German)
  V (3) + Ü (1)
  Module taught in: English

- **Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
  a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)
  Assessment offered: In the semester in which the course is offered and in the subsequent semester
  Language of assessment: English
  creditable for bonus

- **Allocation of places**
  --

- **Additional information**
  --

- **Workload**
  150 h

- **Teaching cycle**
  --

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

- **Module appears in**
  Master's degree (1 major) Mathematics International (2015)
  Master's degree (1 major) Mathematics International (2021)
  Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspects of Geometry</td>
<td>10-M=VGEOin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

In-depth discussion of a special type of geometry taking into account recent developments and interrelations with other mathematical structures, e.g. topological geometries, diagram geometries.

**Intended learning outcomes**

The student is acquainted with advanced results in a selected field of geometry and can apply his/her skills to complex problems.

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

- V (3) + Ü (1)

Module taught in: English

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

- a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

- 

**Additional information**

- 

**Workload**

- 150 h

**Teaching cycle**

- 

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

- 

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master’s degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Continuum Mechanics</td>
<td>10-M=VKOMin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Partial differential equations and/or variational methods in the context of continuum mechanics.

**Intended learning outcomes**

The student masters the mathematical methods in mathematical continuum mechanics and knows about their main fields of application.

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

V (3) + Ü (1)

Module taught in: English

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

a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Mathematical Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviation</td>
<td>10-M=VMBVn-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Mathematical fundamentals of image processing and computer vision such as elementary projective geometry, camera models and camera calibration, rigid and non-rigid registration, reconstruction of 3D objects from camera pictures; algorithms; module might also include an introduction to geometric methods and tomography.

**Intended learning outcomes**

The student masters the mathematical methods in the theory of image processing and knows about their main fields of application.

**Courses**

<table>
<thead>
<tr>
<th>type, number of weekly contact hours, language — if other than German</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (3) + Ü (1)</td>
</tr>
</tbody>
</table>

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Topics in Mathematical Physics</td>
<td>10-M=VMPHin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td></td>
</tr>
</tbody>
</table>

**Contents**

Selected topics in mathematical physics, for example continuum mechanics, fluid dynamics, mathematical material sciences, geometric field theory, advanced topics in quantum theory.

**Intended learning outcomes**

The student is acquainted with an advanced topic in mathematical physics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English
creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Physics International (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Topics in Control Theory</td>
<td>10-M=VRTin-152-mo1</td>
</tr>
</tbody>
</table>

**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**

1 semester

**Module level**

graduate

**Other prerequisites**

--

**Contents**

Selected topics in linear and non-linear control theory, e.g. networked linear control systems, controllability of bilinear systems.

**Intended learning outcomes**

The student gains insight into contemporary research problems in control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master’s degree (1 major) Mathematics International (2021)

Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse Problems</td>
<td>10-M=VIPRin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Linear operator equations, ill-posed problems, regularisation theory, Tikhonov regularisation, iterative regularisation methods, examples of ill-posed problems.

**Intended learning outcomes**

The student can judge whether a given problem is well posed or ill posed. He/She can apply regularisation methods and examine them regarding stability and convergence, and is familiar with selected inverse problems.

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

<table>
<thead>
<tr>
<th>Type (V = Lecture, Ü = Practical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (3) + Ü (1)</td>
</tr>
</tbody>
</table>

Module taught in: English

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

- a) written examination (approx. 60 to 90 minutes, usually chosen) or
- b) oral examination of one candidate each (approx. 15 minutes) or
- c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Theory</td>
<td>10-M=VMTHin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Basics in module theory: modules and module spaces, canonical decomposition and representations, simple, semi-simple and complex modules, module trees and their defibrations, distortion theorems, reduction theorems.

**Intended learning outcomes**
The student masters mathematical methods in module theory and is able to analyse their quality.

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

- **V (3) + Ü (1)**
Module taught in: English

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

- a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
150 h

**Teaching cycle**
--

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

**Module appears in**
- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
## Module Catalogue for the Subject
Mathematics International
Master's with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-linear Analysis</td>
<td>10-M=VNANin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
Methods in nonlinear analysis (e. g. topological methods, monotony and variational methods) with applications.

### Intended learning outcomes
The student is acquainted with the concepts of non-linear analysis, can compare them and assess their applicability on practical problems.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>3</td>
<td>English</td>
</tr>
<tr>
<td>Ü</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Module taught in: English

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

- a) written examination (approx. 60 to 90 minutes, usually chosen) or
- b) oral examination of one candidate each (approx. 15 minutes) or
- c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
Creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
150 h

### Teaching cycle
--

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

--

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal Control</td>
<td>10-M=VOSTin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Basics in optimal control of ordinary and partial differential equations, theory of optimal control, conditions for optimality, methods for numerical solution.

**Intended learning outcomes**
The student is acquainted with advanced methods in optimal control. He gains the ability to work on contemporary research questions in continuous optimization.

**Courses** (type, number of weekly contact hours, language — if other than German)
V (3) + Ü (1)
Module taught in: English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
150 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networked Systems</td>
<td>10-M=VVSYin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Contemporary topics in networked linear and non-linear dynamical systems (homogenous and non-homogenous systems); analysis of control-theoretical aspects (controllability, accessibility, etc.).

**Intended learning outcomes**

The student is acquainted with advanced methods in the field of networked systems. He gains the ability to work on contemporary research questions in networked systems.

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

V (3) + Ü (1)

Module taught in: English

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

a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)

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

Language of assessment: English creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master's degree (1 major) Mathematics International (2021)

Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Geometry</td>
<td>10-M=VKGEin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: Wirtinger calculus, complex structures and complex manifolds, metrics on complex manifolds (e.g., conformal, hermitian, Kähler), differential operators on complex manifolds, classification of complex manifolds.

**Intended learning outcomes**

The student knows and masters advanced methods and notions in complex differential geometry. He is familiar with the central concepts in this field and is able to apply the fundamental proof methods independently.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English
creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module title

Partial Differential Equations of Mathematical Physics

### Abbreviation

10-M=VPDPin-152-m01

### Module coordinator

Dean of Studies Mathematik (Mathematics)

### Module offered by

Institute of Mathematics

### ECTS

10

### Method of grading

numerical grade

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

--

### Duration

1 semester

### Module level

graduate

### Other prerequisites

--

### Contents

Elliptic, parabolic, and hyperbolic equations; Laplace equation, heat equation and wave equation as standard examples; initial and boundary value problems; well-posed and ill-posed problems; solution methods; extensions and generalisations; Hilbert space methods; Sobolev spaces and Fourier transforms.

### Intended learning outcomes

The student is acquainted with fundamental concepts and solution methods in the theory of partial differential equations, as well as standard examples from mathematical physics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

### Courses

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

V (4) + Ü (2)

Module taught in: English

### Method of assessment

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English
creditable for bonus

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

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

--

### Module appears in

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Physics International (2020)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
## Module: Pseudo Riemannian and Riemannian Geometry

**Module title:** Pseudo Riemannian and Riemannian Geometry  
**Abbreviation:** 10-M=VPRGin-152-m01  

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

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: Riemannian and pseudo-Riemannian manifolds, Levi-Civita connection and curvature, geodesics and the exponential map, Jacobi fields, comparison theorems in Riemannian geometry, submanifolds, integration, d'Alembert and Laplace operators, causal structure of Lorenz manifolds, Einstein equations and applications in general relativity theory.

### Intended learning outcomes
The student is acquainted with advanced topics in differential geometry on Riemannian and pseudo-Riemannian manifolds. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

### Courses
<table>
<thead>
<tr>
<th>Type</th>
<th>Number of weekly contact hours, language</th>
<th>if other than German</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>(4) + Ü (2)</td>
<td>English</td>
</tr>
</tbody>
</table>

**Module taught in:** English

### Method of assessment
- a) written examination (approx. 90 to 120 minutes, usually chosen)  
- b) oral examination of one candidate each (approx. 20 minutes)  
- c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

**Language of assessment:** English  
**creditable for bonus**

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

### Module appears in
- Master's degree (1 major) Mathematics International (2015)  
- Master's degree (1 major) Physics International (2020)  
- Master's degree (1 major) Mathematics International (2021)  
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Analysis</td>
<td>10-M=AFANin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Banach and Hilbert spaces, bounded operators, principles of functional analysis, further contemporary topics in functional analysis and applications to other fields of mathematics.

**Intended learning outcomes**
The student is acquainted with fundamental concepts and methods in a contemporary field of functional analysis, and is able to apply these skills to complex questions.

**Courses**
(V (4) + Ü (2))
Module taught in: English

**Method of assessment**
(a) written examination (approx. 90 to 120 minutes, usually chosen) or
(b) oral examination of one candidate each (approx. 20 minutes) or
(c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
## Applied Differential Geometry

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

### Module offered by
Institute of Mathematics

### ECTS
10

### Method of grading
numerical grade

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
The module builds on the topics covered in module 10-M=ADGM and discusses selected applications of differential geometry, e.g. at the interface of control theory and mechanics (subriemannian geometry), in the smooth optimisation on manifolds or applications in physics.

### Intended learning outcomes
The student is acquainted with selected advanced applications of differential geometry. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

### Courses
(V 4) + Ü (2)
Module taught in: English

### Method of assessment
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English
creditable for bonus

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giovanni Prodi Lecture Selected Topics (Master)</td>
<td>10-M=VGPSin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Introduction to a specialised topic in mathematics by an international expert.

**Intended learning outcomes**

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

**Courses**

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

V (4) + Ü (2)

Module taught in: English

**Method of assessment**

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English

creditable for bonus

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's degree (1 major) Mathematical Physics (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Mathematical Physics (2022)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giovanni Prodi Lecture Advanced Topics (Master)</td>
<td>10-M=VGPAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to a specialised topic in mathematics by an international expert.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intended learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Courses (type, number of weekly contact hours, language — if other than German)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (4) + Ü (2)</td>
</tr>
<tr>
<td>Module taught in: English</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)</td>
</tr>
<tr>
<td>Assessment offered: In the semester in which the course is offered and in the subsequent semester</td>
</tr>
<tr>
<td>Language of assessment: English</td>
</tr>
<tr>
<td>creditable for bonus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allocation of places</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Referred to in LPO I (examination regulations for teaching-degree programmes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module appears in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master's degree (1 major) Mathematics International (2015)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics (2016)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematical Physics (2016)</td>
</tr>
<tr>
<td>Master's degree (1 major) Computational Mathematics (2016)</td>
</tr>
<tr>
<td>Master's degree (1 major) Computational Mathematics (2019)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics (2019)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematical Physics (2020)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics International (2021)</td>
</tr>
<tr>
<td>Master's degree (1 major) Computational Mathematics (2022)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematics (2022)</td>
</tr>
<tr>
<td>Master's degree (1 major) Mathematical Physics (2022)</td>
</tr>
</tbody>
</table>
Module title
Giovanni Prodi Lecture Modern Topics (Master)

Abbreviation
10-M=VGPM-In-152-m01

Module coordinator
Dean of Studies Mathematik (Mathematics)

Module offered by
Institute of Mathematics

ECTS
10

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

10 numerical grade

Duration
1 semester

Module level
graduate

Other prerequisites
--

Contents
Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes
The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)

Module taught in: English

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

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate)

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

Language of assessment: English
creditable for bonus

Allocation of places
--

Additional information
--

Workload
300 h

Teaching cycle
--

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

Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's degree (1 major) Mathematical Physics (2020)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Mathematical Physics (2022)
Research in Groups and Seminars
(20-60 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Algebra</td>
<td>10-M=GALGin-152-m01</td>
</tr>
</tbody>
</table>

**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**

1 semester

**Module level**

graduate

**Other prerequisites**

--

**Contents**

Selected modern topics in algebra (e. g. ring theory, commutative algebra, differential algebra, local fields, computer algebra, algebras, division rings, quadratic forms).

**Intended learning outcomes**

The student gains insight into contemporary research problems in algebra. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**

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

V (2) + S (2)

Module taught in: English

**Method of assessment**

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

talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master's degree (1 major) Mathematics International (2021)

Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Discrete Mathematics</td>
<td>10-M=GDIMin-152-m01</td>
</tr>
</tbody>
</table>

**Module coordinator**

Dean of Studies Mathematik (Mathematics)  
Institute of Mathematics

**ECTS**

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in discrete mathematics.

**Intended learning outcomes**

The student gains insight into contemporary research problems in discrete mathematics. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of weekly contact hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (2) + S (2)</td>
<td>English</td>
<td></td>
</tr>
</tbody>
</table>

Module taught in: English

**Method of assessment**

<table>
<thead>
<tr>
<th>Type</th>
<th>Scope</th>
<th>Language</th>
<th>Examination offered</th>
<th>Module is creditable for bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>talk (60 to 120 minutes)</td>
<td>Assessment offered: In the semester in which the course is offered and in the subsequent semester</td>
<td>English</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)  
Master's degree (1 major) Mathematics International (2021)  
Master's degree (1 major) Mathematics International (2022)
## Module Catalogue for the Subject
### Mathematics International
#### Master's with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Dynamical Systems and Control Theory</td>
<td>10-M=GDSCin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

Selected modern topics in dynamical systems and control theory.

### Intended Learning Outcomes

The student gains insight into contemporary research problems in dynamical systems and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

### Courses

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of weekly contact hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>2</td>
<td>English</td>
</tr>
<tr>
<td>S</td>
<td>2</td>
<td>English</td>
</tr>
</tbody>
</table>

Module taught in: English

### Method of Assessment

- **Type**: talk
- **Scope**: 60 to 120 minutes
- **Language**: English
- **Assessment offered**: In the semester in which the course is offered and in the subsequent semester
- **Allocation of places**: --

### Additional Information

- **Workload**: 300 h
- **Teaching cycle**: --
- **Referred to in LPO I**: (examination regulations for teaching-degree programmes)
- **Module appears in**:
  - Master's degree (1 major) Mathematics International (2015)
  - Master's degree (1 major) Mathematics International (2021)
  - Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Complex Analysis</td>
<td>10-M=GCOAin-152:m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
Selected modern topics in complex analysis (e.g. in approximation theory, potential theory, complex dynamics, geometric complex analysis, value distribution theory).

### Intended learning outcomes
The student gains insight into contemporary research problems in complex analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

- V (2) + S (2)
  
  Module taught in: English

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

- talk (60 to 120 minutes)
  
  Assessment offered: In the semester in which the course is offered and in the subsequent semester
  
  Language of assessment: English

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

--

### Module appears in

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
**Module title**  
Research in Groups - Geometry and Topology

**Abbreviation**  
10-M-GGMTin-152-m01

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

**Module offered by**  
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**  
1 semester

**Module level**  
graduate

**Other prerequisites**  
--

**Contents**  
Selected modern topics in geometry and topology.

**Intended learning outcomes**  
The student gains insight into contemporary research problems in geometry and topology. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)  
Module taught in: English

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

talk (60 to 120 minutes)  
Assessment offered: In the semester in which the course is offered and in the subsequent semester  
Language of assessment: English

**Allocation of places**  
--

**Additional information**  
--

**Workload**  
300 h

**Teaching cycle**  
--

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

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
## Module Title

**Research in Groups - Mathematics in Context**

**Abbreviation:**
10-M=GMCXin-152-m01

## Module Coordinator

Dean of Studies Mathematik (Mathematics)

## Module Offered by

Institute of Mathematics

## ECTS

10

## Method of Grading

numerical grade

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

--

## Duration

1 semester

## Module Level

graduate

## Other Prerequisites

--

## Contents

Reflection on mathematics in a cultural context, for example by discussing part of the history of mathematics, given by a historical period, a geographic region or a particular field of mathematics. Other possibilities arise from the connection of mathematics with literature, language, music, art or the media.

## Intended Learning Outcomes

The student realises the cultural dimension of mathematics and its relation to other cultural fields.

## Courses

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

V (2) + S (2)

Module taught in: English

## Method of Assessment

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

talk (60 to 120 minutes)

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

Language of assessment: English

## Allocation of Places

--

## Additional Information

--

## Workload

300 h

## Teaching Cycle

--

## Referred to in LPO I

(examination regulations for teaching-degree programmes)

--

## Module Appears In

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Mathematics in the Sciences</td>
<td>10-M=GMSCin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in mathematics in the sciences.

**Intended learning outcomes**

The student gains insight into contemporary research problems in mathematics in the sciences. He/She masters advanced techniques in this field and can apply them to complex problems.

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

- V (2) + S (2)
  - Module taught in: English

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

- talk (60 to 120 minutes)
  - Assessment offered: In the semester in which the course is offered and in the subsequent semester
  - Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
### Module title
Research in Groups - Measure and Integral  

### Abbreviation
10-M=GMAin-152-m01

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

### Module offered by
Institute of Mathematics

### ECTS
10

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
Aspects of measure and integration theory: sigma algebras and Borel sets, volume and measure, measurable functions and Lebesgue integrals, selected applications, e.g. product measures (with Fubini’s theorem and the transformation rule), Lp spaces and absolute continuity, measures on topological spaces.

### Intended learning outcomes
The student gains insight into contemporary research problems in measure and integration theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)

Module taught in: English

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

talk (60 to 120 minutes)

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

Language of assessment: English

### Allocation of places
--

### Additional information
--

### Workload
300 h

### Teaching cycle
--

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

--

### Module appears in
MASTER’S DEGREE (1 MAJOR) MATHEMATICS INTERNATIONAL (2015)

MASTER’S DEGREE (1 MAJOR) MATHEMATICS INTERNATIONAL (2021)

MASTER’S DEGREE (1 MAJOR) MATHEMATICS INTERNATIONAL (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Numerical Mathematics and Applied Analysis</td>
<td>10-M=GNMAin-152-m01</td>
</tr>
</tbody>
</table>

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

### Module offered by
Institute of Mathematics

### ECTS
- 10

### Method of grading
- numerical grade

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

### Duration
- 1 semester

### Module level
- graduate

### Other prerequisites
- --

### Contents
Selected topics in numerical mathematics, applied analysis or scientific computing.

### Intended learning outcomes
The student gains insight into a contemporary research problems in numerical mathematics or applied analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

### Courses
(V (2) + S (2))

Module taught in: English

### Method of assessment
- talk (60 to 120 minutes)

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

Language of assessment: English

### Allocation of places
- --

### Additional information
- --

### Workload
- 300 h

### Teaching cycle
- --

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

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module: Research in Groups - Robotics, Optimization and Control Theory

**Module title**: Research in Groups - Robotics, Optimization and Control Theory

**Abbreviation**: 10-M=GROCin-152-m01

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

**Module offered by**: Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in robotics, optimisation and control theory.

**Intended learning outcomes**

The student gains insight into contemporary research problems in robotics, optimization and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)

Module taught in: English

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

Talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
## Module Catalogue for the Subject Mathematics International

### Master's with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Time Series Analysis</td>
<td>10-M=GTSAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

Selected modern topics in time series analysis.

### Intended learning outcomes

The student gains insight into contemporary research problems in time series analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>2</td>
<td>English</td>
</tr>
<tr>
<td>S</td>
<td>2</td>
<td>English</td>
</tr>
</tbody>
</table>

Module taught in: English

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

- **talk (60 to 120 minutes)**
- Assessment offered: In the semester in which the course is offered and in the subsequent semester
- Language of assessment: English

### Allocation of places

--

### Additional information

--

### Workload

300 h

### Teaching cycle

--

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

--

### Module appears in

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Statistics</td>
<td>10-M=GSTAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in statistics.

**Intended learning outcomes**

The student gains insight into contemporary research problems in statistics. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**

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

V (2) + S (2)

Module taught in: English

**Method of assessment**

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

Talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Number Theory</td>
<td>10-M=GNTHIn-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in number theory (e.g. algebraic number theory, modular forms, diophantine analysis).

**Intended learning outcomes**

The student gains insight into contemporary research problems in number theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)

Module taught in: English

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

Talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)

Master's degree (1 major) Mathematics International (2021)

Master's degree (1 major) Mathematics International (2022)
**Module title**  
Research in Groups - Control Theory of Quantum Mechanical Systems

**Abbreviation**  
10-M=GCQSin-152-m01

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

**Module offered by**  
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in control theory of quantum mechanical systems.

**Intended learning outcomes**

The student gains insight into contemporary research problems in control theory of quantum mechanical systems. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)

Module taught in: English

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

talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

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

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Differential Geometry</td>
<td>10-M=GDGEin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Selected modern topics in differential geometry.

**Intended learning outcomes**
The student gains insight into contemporary research problems in Differential Geometry. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
Module taught in: English

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

Talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

--

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
## Module title
Research in Groups - Deformation Quantization

<table>
<thead>
<tr>
<th>Module title: Research in Groups - Deformation Quantization</th>
<th>Abbreviation: 10-M=GDFQin-152-m01</th>
</tr>
</thead>
</table>

## Module coordinator
Dean of Studies Mathematik (Mathematics)

## Module offered by
Institute of Mathematics

## ECTS
10

## Method of grading
Numerical grade

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

## Duration
1 semester

## Module level
Graduate

## Other prerequisites
--

## Contents
Selected modern topics in deformation quantization.

## Intended learning outcomes
The student gains insight into contemporary research problems in Deformation Quantization. He/She masters advanced techniques in this field and can apply them to complex problems.

## Courses
**Type, number of weekly contact hours, language — if other than German**

- Type: V + S
- Number of weekly contact hours: 2 + 2
- Language: English

## Module taught in: English

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

- Type: Talk
- Scope: 60 to 120 minutes
- Language: English
- Assessment offered: In the semester in which the course is offered and in the subsequent semester
- Language of assessment: English

## Allocation of places
--

## Additional information
--

## Workload
300 h

## Teaching cycle
--

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

## Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Non-linear Analysis</td>
<td>10-M=GNLAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
Selected modern topics in non-linear analysis.

**Intended learning outcomes**
The student gains insight into contemporary research problems in Non-linear Analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**
(type, number of weekly contact hours, language — if other than German)
V (2) + S (2)
Module taught in: English

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

**Allocation of places**
--

**Additional information**
--

**Workload**
300 h

**Teaching cycle**
--

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

**Module appears in**
Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research in Groups - Operator Algebras</td>
<td>10-M=GOPAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Selected modern topics in operator algebras.

**Intended learning outcomes**

The student gains insight into contemporary research problems in Operator algebras. He/She masters advanced techniques in this field and can apply them to complex problems.

**Courses**

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

V (2) + S (2)

Module taught in: English

**Method of assessment**

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

Talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

300 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)

Master’s degree (1 major) Mathematics International (2021)

Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Applied Differential Geometry</td>
<td>10-M=SADGin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in applied differential geometry.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module taught in:</td>
<td>English</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Scope</th>
<th>Language</th>
<th>Assessment offered</th>
<th>Language of assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>talk</td>
<td>60 to 120 minutes</td>
<td>English</td>
<td>In the semester in which the course is offered and in the subsequent semester</td>
<td>English</td>
</tr>
</tbody>
</table>

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Algebra</td>
<td>10-M=SALGin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents

A modern topic in algebra.

### Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)

Module taught in: English

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

Talk (60 to 120 minutes)

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

Language of assessment: English

### Allocation of places

--

### Additional information

--

### Workload

150 h

### Teaching cycle

--

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

--

### Module appears in

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Dynamical Systems and Control</td>
<td>10-M=SDSCin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**
1 semester

**Module level**
graduate

**Contents**
A modern topic in dynamical systems and control.

**Intended learning outcomes**
The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
Module taught in: English

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

Talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

**Allocation of places**
--

**Additional information**
--

**Workload**
150 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Complex Analysis</td>
<td>10-M=SCOAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in complex analysis.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

<table>
<thead>
<tr>
<th>S (2)</th>
</tr>
</thead>
</table>

Module taught in: English

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

<table>
<thead>
<tr>
<th>talk (60 to 120 minutes)</th>
</tr>
</thead>
</table>

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Financial and Insurance Mathematics</td>
<td>10-M=SFiMin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in financial and insurance mathematics.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)

Module taught in: English

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

talk (60 to 120 minutes)

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

Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Geometry and Topology</td>
<td>10-M=SGTOin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in geometry and topology.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

<table>
<thead>
<tr>
<th>S (2)</th>
<th>Module taught in: English</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>talk (60 to 120 minutes)</th>
<th>Assessment offered: In the semester in which the course is offered and in the subsequent semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of assessment: English</td>
<td></td>
</tr>
</tbody>
</table>

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giovanni Prodi Seminar (Master)</td>
<td>10-M=SGPCin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in the research expertise of the current holder of the Giovanni Prodi Chair.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

<table>
<thead>
<tr>
<th>S (2)</th>
</tr>
</thead>
</table>

Module taught in: English

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

<table>
<thead>
<tr>
<th>talk (60 to 120 minutes)</th>
</tr>
</thead>
</table>

Assessment offered: In the semester in which the course is offered and in the subsequent semester Language of assessment: English

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

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

--

**Module appears in**

- Master's degree (1 major) Mathematics International (2015)
- Master's degree (1 major) Mathematics (2016)
- Master's degree (1 major) Economathematics (2016)
- Master's degree (1 major) Mathematical Physics (2016)
- Master's degree (1 major) Computational Mathematics (2016)
- Master's degree (1 major) Mathematical Physics (2019)
- Master's degree (1 major) Computational Mathematics (2019)
- Master's degree (1 major) Mathematics (2019)
- Master's degree (1 major) Mathematical Physics (2020)
- Master's degree (1 major) Mathematics International (2021)
- Master's degree (1 major) Economathematics (2021)
- Master's degree (1 major) Computational Mathematics (2022)
- Master's degree (1 major) Mathematics (2022)
- Master's degree (1 major) Mathematical Physics (2022)
- Master's degree (1 major) Mathematics International (2022)
Master’s degree (1 major) Economathematics (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interdisciplinary Seminar</td>
<td>10-M=SIDCin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

A modern topic in mathematics with interdisciplinary aspects.

**Intended learning outcomes**

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

**Courses**

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

<table>
<thead>
<tr>
<th>S (2)</th>
<th>Module taught in: English</th>
</tr>
</thead>
</table>

**Method of assessment**

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

<table>
<thead>
<tr>
<th>talk (60 to 120 minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment offered: In the semester in which the course is offered and in the subsequent semester</td>
</tr>
<tr>
<td>Language of assessment: English</td>
</tr>
</tbody>
</table>

**Allocation of places**

--

**Additional information**

--

**Workload**

150 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master’s degree (1 major) Mathematics International (2015)
Master’s degree (1 major) Mathematics International (2021)
Master’s degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar Mathematics in the Sciences</td>
<td>10-M=SMSCin-152-m01</td>
</tr>
</tbody>
</table>

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

**Module offered by**
Institute of Mathematics

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**Contents**
A modern topic in mathematics in the sciences.

**Intended learning outcomes**
The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

| S (2) | Module taught in: English |

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

talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

**Allocation of places**
--

**Additional information**
--

**Workload**
150 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module title
Seminar in Numerical Mathematics and Applied Analysis

### Abbreviation
10-M=SNMAin-152-m01

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

### Contents
A modern topic in numerical mathematics or applied analysis.

### Intended learning outcomes
The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

### Courses (type, number of weekly contact hours, language — if other than German)
S (2)
Module taught in: English

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

### Allocation of places
--

### Additional information
--

### Workload
150 h

### Teaching cycle
--

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

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module title

**Seminar in Optimization**

### Abbreviation

10-M=SOPTin-152-m01

### Module coordinator

Dean of Studies Mathematik (Mathematics)

### Module offered by

Institute of Mathematics

### ECTS

5

### Method of grading

numerical grade

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

--

### Duration

1 semester

### Module level

graduate

### Other prerequisites

--

### Contents

A modern topic in optimisation.

### Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)

Module taught in: English

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

Talk (60 to 120 minutes)

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

Language of assessment: English

### Allocation of places

--

### Additional information

--

### Workload

150 h

### Teaching cycle

--

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

--

### Module appears in

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar in Statistics</td>
<td>10-M=SSTAin-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**
A modern topic in statistics.

**Intended learning outcomes**
The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

**Courses** (type, number of weekly contact hours, language — if other than German)
S (2)
Module taught in: English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
talk (60 to 120 minutes)
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: English

**Allocation of places**
--

**Additional information**
--

**Workload**
150 h

**Teaching cycle**
--

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

**Module appears in**
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
### Module title
Seminar in Non-linear Analysis

### Abbreviation
10-M=SNLAin-152-m01

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

### Module offered by
Institute of Mathematics

### ECTS
5

### Method of grading
Numerical grade

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

### Duration
1 semester

### Module level
Graduate

### Other prerequisites
--

### Contents
A modern topic in non-linear analysis.

### Intended learning outcomes
The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>(2)</td>
<td>English</td>
</tr>
</tbody>
</table>

Module taught in: English

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Scope</th>
<th>Language</th>
<th>Examination offered</th>
<th>Information on creditable for bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk</td>
<td>(60 to 120 minutes)</td>
<td>English</td>
<td>In the semester in which the course is offered and in the subsequent semester</td>
<td></td>
</tr>
</tbody>
</table>

Language of assessment: English

### Allocation of places
--

### Additional information
--

### Workload
150 h

### Teaching cycle
--

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

--

### Module appears in
Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)
Thesis

(30 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Thesis Mathematics International</td>
<td>10-M=MAMI-152-m01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>numerical grade</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>--</td>
</tr>
</tbody>
</table>

**Contents**

Indepedently researching and writing on a topic in mathematics 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 master programme. He/She can write down the result of his/her work in English language in a suitable form.

**Courses**

No courses assigned to module

**Method of assessment**

Master's thesis (750 to 900 hours total)
Registration and assignment of topic in consultation with supervisor.
Language of assessment: English

**Allocation of places**

--

**Additional information**

Time to complete: 6 months.

**Workload**

900 h

**Teaching cycle**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Mathematics International (2015)
Master's degree (1 major) Mathematics International (2021)
Master's degree (1 major) Mathematics International (2022)