

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: 2021 Responsible: Faculty of Mathematics and Computer Science Responsible: Institute of Mathematics



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The subject is divided into

section / sub-section	ECTS credits	starting page
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Mathematics	30-70	8
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Thesis	30	105



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

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:

ASP02015

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

03-Feb-2021 (2021-6)

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			Abbreviation		
Applied Analysis				10-M=AAANin-152-m01	
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathematics)			thematics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. co	ompl. of module(s)	
10	nume	rical grade			
Duration Module level Othe		Other prerequisite	es		
1 semester graduate					
C					

In-depth study of functional analysis and operator theory, Sobolev spaces and partial differential equations, theory of Hilbert spaces and Fourier analysis, spectral theory and quantum mechanics, numerical methods (in particular FEM methods), principles of functional analysis, function spaces, embedding theorems, compactness, theory of elliptic, parabolic and hyperbolic partial differential equations with methods from functional analysis.

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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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
Topics in Algebra					10-M=AALGin-152-m01
Module	Module coordinator			Module offered by	I
Dean of	f Studi	es Mathematik (Mathen	natics)	Institute of Mathem	natics
ECTS	TS Method of grading Only after succ. cor			mpl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisites	3	
1 semes	ster	graduate			
Conten	ts				
Contemporary topics in algebra, for example coding theory, elliptic curves, algebraic combinatorics or computer algebra.					
Intende	ed lear	ning 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.

 $\textbf{Courses} \ (\textbf{type}, \, \textbf{number of weekly contact hours, language} - \textbf{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title				Abbreviation	
Differential Geometry				10-M=ADGMin-152-m01	
Module coordinator				Module offered by	
Dean o	of Studi	es Mathematik (Mathem	atics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. compl. of module(s)		
10	nume	rical grade			
Duration Module level		Other prerequisites			
1 semester graduate					
Conter	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 geome-

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

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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)



Modul	e title		Abbreviation		
Complex Analysis					10-M=AFTHin-152-m01
Modul	e coord	inator		Module offered by	
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. cor	ompl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites	3	
1 semester graduate					
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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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
Geometric Structures				10-M=AGMSin-152-m01	
Module coordinator				Module offered by	
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duration Module level		Other prerequisites			
1 semester graduate					
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)

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Module appears in

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

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



Module title					Abbreviation
ndustrial Statistics 1					10-M=AISTin-152-m01
Module coordinator				Module offered by	
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
		meter and domain estim			bution models, empirical distring, audit sampling.
Intende	ed learı	ning outcomes			
The stu	dent m	asters the fundamental	statistical methods fo	or industrial applicat	ions.
Course	S (type, n	number of weekly contact hours,	language — if other than Ger	man)	
V (4) + Module		t in: English			
		Sessment (type, scope, langua	age — if other than German, o	examination offered — if no	ot every semester, information on whether
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					
Additio	nal inf	ormation			

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module	e title		Abbreviation		
Lie Theory				10-M=ALTHin-152-m01	
Module coordinator				Module offered by	
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)	
10	nume	rical grade			
Duration Module level		Other prerequisites			
1 semester graduate					
Conten	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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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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						
c of La	rge Systems of Equati	ions		10-M=ANGGin-152-m01		
coord	inator		Module offered by			
Dean of Studies Mathematik (Mathematics)			Institute of Mathen	natics		
Metho	od of grading	Only after succ. cor	npl. of module(s)			
numei	rical grade					
n	Module level	Other prerequisites	i			
ster	graduate					
ts		,				
sation	of elliptic differential	equations, classical ite	ration methods, pred	conditioners, multigrid methods.		
d learr	ning outcomes					
	•	•		rstems of equations, and knows		
Ü (2) taugh	t in: English					
		nguage — if other than German,	examination offered — if no	ot every semester, information on whether		
x. 20 m ment o ge of a	inutes) or c) oral exan ffered: In the semeste ssessment: English	nination in groups (grou	ps of 2, 15 minutes p	per candidate)		
ion of p	olaces					
nal info	ormation					
		,				
ad						
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)						
s degre		tics International (2015)				
	coord Studio Metho nume n ster ss sation d learn dent is st effici st effici taugh of ass creditab en exan . 20 m ment o ge of a ole for on of p	Coordinator Studies Mathematik (Mathematik of grading numerical grade Module level Ster graduate Station of elliptic differential of learning outcomes dent is acquainted with the st efficient way to solve a give of stype, number of weekly contact how of type, number of weekly contact how of assessment (type, scope, land creditable for bonus) En examination (approx. 90 or all examination of fered: In the semester of assessment: English on of places The place of t	Method of grading numerical grade n Module level graduate ster graduate ts sation of elliptic differential equations, classical ite d learning outcomes dent is acquainted with the most important method st efficient way to solve a given system of equations (type, number of weekly contact hours, language — if other than Ge d) (2) taught in: English of assessment (type, scope, language — if other than German, creditable for bonus) en examination (approx. 90 to 120 minutes, usually 20 minutes) or c) oral examination in groups (groument offered: In the semester in which the course is ge of assessment: English on of places mal information ad d to in LPO I (examination regulations for teaching-degree progra	Coordinator Studies Mathematik (Mathematics) Institute of Mathematics of Mathem		



Module title					Abbreviation
Basics in Optimization					10-M=AOPTin-152-m01
Module coordinator				Module offered by	
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)	
10	nume	rical grade			
Duration Module level Othe		Other prerequisites	3		
1 semester graduate					
Conter	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 econo-

Intended learning outcomes

The student knows the fundamental methods of continous 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)

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Module appears in

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

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



Module	e title	-	Abbreviation			
Control Theory					10-M=ARTHin-152-m01	
Module coordinator				Module offered by		
Dean o	Dean of Studies Mathematik (Mathematics)			ics) Institute of Mathematics		
ECTS	Metho	od of grading	Only after succ. con	ompl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conten	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)

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Module appears in

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

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



Modul	e title		Abbreviation			
Stochastic Models of Risk Management					10-M=ASMRin-152-mo1	
Modul	e coord	linator		Module offer	ed by	
Dean c	of Studi	es Mathematik (Mat	hematics)	Institute of M	athematics	
ECTS	Meth	Method of grading Only after succ. compl. of m		c. compl. of module	(s)	
10	nume	rical grade				
Duratio	on	Module level	Other prerequ	isites		
seme	ester	graduate				
Contents						
res, va	lue at r	isk, conditional valu	e at risk, axiomatic o	of risk measures, mo	essment in auditing, shortfall measu	

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

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation		
Stocha	stical I	Processes		10-M=ASTPin-152-m01			
Module coordinator Module offer					I.		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)			
10	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ester	graduate					
Conter	nts						
Markov	v chain	s, queues, stochastic pro	cesses in C[o,1], Brov	wnian motion, Donsl	ker's theorem, projective limits.		
Intend	ed lear	ning outcomes					
		acquainted with the fun	damental notions an	d methods of stocha	astical processes and can apply		
Course	S (type, i	number of weekly contact hours,	language — if other than Gei	man)			
V (4) +	Ü (2)	t in: English					
		sessment (type, scope, langua ole for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether		
(appro Assess Langua	x. 20 m sment o	inutes) or c) oral examin ffered: In the semester in ssessment: English	ation in groups (grou	ps of 2, 15 minutes p			
Allocat	tion of	places					
Additio	Additional information						
Workload							
300 h							
Teaching cycle							

 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Master's degree (1 major) Mathematics International (2015) Master's degree (1 major) Mathematics International (2021)

Module appears in



Modul	e title				Abbreviation
Topolo	ogy				10-M=ATOPin-152-m01
Module coordinator				Module offered by	<u> </u>
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	Duration Module level Ot		Other prerequisites		
1 semester graduate					

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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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	e title		Abbreviation			
Insurai	nce Ma	thematics 1			10-M=AVSMin-152-m01	
Module coordinator				Module offered by		
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	5		
1 seme	1 semester graduate					
Conten	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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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Module appears in

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

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



Modul	Module title Abbreviation					
Time S	eries A	nalysis 1			10-M=AZRAin-152-m01	
Modul	Module coordinator M					
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	its					
Additiv	e mode	el, linear filters, autocor	relation, moving avera	ge, autoregressive p	processes, Box-Jenkins method.	
Intend	ed learı	ning outcomes				
The stu proble		acquainted with the fu	ndamental methods o	f time series analysi	s and can apply them to practical	
Course	S (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: English				
		sessment (type, scope, langule for bonus)	uage — if other than German,	examination offered — if no	ot every semester, information on whether	
(appro Assess Langua	x. 20 m ment o	inutes) or c) oral exami ffered: In the semester ssessment: English	nation in groups (grou	ps of 2, 15 minutes p		
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teaching cycle						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Modul	Module appears in					
Master	Master's degree (1 major) Mathematics International (2015)					



Modul	e title		Abbreviation			
Numbe	er Theo	ry			10-M=AZTHin-152-m01	
Module coordinator				Module offered by		
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
10	nume	rical grade				
Duratio	Duration Module level Other		Other prerequisites	S		
1 seme	1 semester graduate					
Conter	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 analytics 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 (type, number of weekly contact hours, language - if other than German)

 $V(4) + \ddot{U}(2)$

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
Giovan	ıni Prod	i Lecture (Master)			10-M=AGPCin-152-m01
Module coordinator				Module offered by	
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathematics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duratio	Duration Module level		Other prerequisites		
1 seme	1 semester graduate				

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.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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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) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)



Module	e title			Abbreviation		
Selected Topics in Analysis					10-M=VANAin-152-m01	
Module	e coord	inator		Module offered by	I.	
Dean o	f Studi	es Mathematik (Math	nematics)	Institute of Mathen	natics	
ECTS	Metho	od of grading	Only after succ. co	mpl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites	Other prerequisites		
1 seme	ster	graduate				
Conten	its					
		ussion of a specialise thematical concepts	•	g into account recent	t developments and interrelations	
Intend	ed lear	ning outcomes				
The stu		-	vanced results in a selec	ted topic in analysis,	and is able to apply these to	
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						

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

module is creditable for bonus)

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation
Algebraic Topology					10-M=VATPin-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studie	es Mathematik (Mathem	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	its				
Homolo spaces	•,	motopy invariance, exac	t sequences, cohomo	logy, application to	the topology of Euclidean
Intend	ed learı	ning outcomes			
The stu	ıdent is	acquainted with advance	ced results in algebrai	ic topology.	
Course	S (type, n	number of weekly contact hours,	language — if other than Ger	rman)	
V (4) + Module		t in: English			
		Sessment (type, scope, langua le for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether
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					
Additio	nal inf	ormation			

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)



	d Topic			Module title Abbro				
Module	Selected Topics in Financial Mathematics 10-M=VFNMin-152-mo1							
Module	coord	inator	Module offered by					
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathen	natics			
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)				
10	numei	rical grade						
Duratio	n	Module level	Other prerequisites	i				
1 semes	ster	graduate						
Conten	ts							
of asset	t pricin		te spaces, American	put, Snell envelope,	tingales, fundamental theorem stopping time, optimal stopping, Merton-Scholes model.			
Intende	d learr	ning outcomes						
					She gains the ability to work on er skills to complex problems.			
Course	S (type, n	umber of weekly contact hours,	language — if other than Ger	rman)				
V (4) + i Module		t in: English						
		essment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if n	ot every semester, information on whether			
approx Assessı	x. 20 m ment o ge of a	inutes) or c) oral examin ffered: In the semester in ssessment: English	ation in groups (grou	ps of 2, 15 minutes p				
Allocati	ion of p	laces						
Additional information								
300 h								
Teaching cycle								

Module appears in

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

 $\textbf{Referred to in LPO I} \ \ (\text{exam} \text{ination regulations for teaching-degree programmes})$

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



Module title					Abbreviation
Groups and their Representations			;		10-M=VGDSin-152-m01
Module coordinator				Module offere	ed by
Dean	of Studi	es Mathematik (Mat	hematics)	Institute of Ma	athematics
ECTS	Meth	od of grading	Only after succ	compl. of module(s)
10	nume	rical grade			
Duration Module level Other prer		Other prerequis	ites		
1 seme	1 semester graduate				
Conte	ntc	-			

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

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Additional information

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Workload

300 h

Teaching cycle

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$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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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		
Geome	etrical N	Mechanics			10-M=VGEMin-152-m01	
Module	e coord	inator		Module offered by		
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Metho	hod of grading Only after succ. co		npl. of module(s)		
10	nume	rical grade	al grade			
Duratio	Duration Module level		Other prerequisites			
1 seme	1 semester graduate					
Conten	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 (type, number of weekly contact hours, language - if other than German)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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
Industrial Statistics 2					10-M=VISTin-152-m01
Module coordinator				Module offered by	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathematics	
ECTS	TS Method of grading O		Only after succ. compl. of module(s)		
10	numerical grade				
Duratio	n	Module level	Other prerequisites		
1 semester graduate		graduate		-	
Contents					
Linear models, regression analysis, nonlinear regression, experimental design, basics in time series modelling, 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 (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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation	
Field A	rithme	tics			10-M=VKARin-152-m01	
Modul	e coord	linator		Module offered by		
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Meth	Method of grading Only after succ. co		mpl. of module(s)		
10	nume	rical grade	ical grade			
Duration Module level		Other prerequisites	Other prerequisites			
1 seme	1 semester graduate					
Conter	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)

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Module appears in

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

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



Module title				Abbreviation		
Numer	ric of Pa	rtial Differential Equatio	ons		10-M=VNPEin-152-m01	
Modul	e coord	inator		Module offered by		
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Meth	ethod of grading Only after succ. con		npl. of module(s)		
10	nume	rical grade				
Duration Module level		Other prerequisites				
1 semester		graduate				
Conto	Contonts					

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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	
Selecte	ed Topi	cs in Optimization			10-M=VOPTin-152-m01
Module	e coord	inator		Module offered by	
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Metho	ethod of grading Only after succ. co		npl. of module(s)	
10	nume	rical grade			
Duration Module level		Other prerequisites	Other prerequisites		
1 semester		graduate			
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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation	
Statistical Analysis					10-M=VSTAin-152-m01	
Modul	e coord	linator		Module offered by		
Dean c	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Meth	ethod of grading Only after succ. co		mpl. of module(s)		
10	nume	merical grade				
Duration Module le		Module level	Other prerequisites	Other prerequisites		
1 semester graduate		graduate				
Conter	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

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of fered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of fered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language}) \ (\textbf{type}, \textbf{language})$

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)



Module t	itle		Abbreviation				
Insuranc	e Mathematics 2			10-M=VVSMin-152-m01			
Module c	coordinator		Module offered by				
Dean of Studies Mathematik (Mathematics)			Institute of Mathen	Institute of Mathematics			
ECTS N	Method of grading	Only after succ. co	ompl. of module(s)				
10 n	iumerical grade						
Duration	Module level	Other prerequisite	Other prerequisites				
1 semest	er graduate						
Contents							

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation
Time Series Analysis 2					10-M=VZRAin-152-m01
Module	coord	inator		Module offered by	<u>'</u>
Dean o	f Studi	es Mathematik (Ma	hematics)	Institute of Mathe	matics
ECTS	Metho	od of grading	Only after succ. co	ompl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisit	es	
1 seme	ster	graduate			
Conten	ts				
State-s varianc			r, frequency spaces, Fou	rier analysis, periodo	grams, characterisation of autoco
Intend	ed lear	ning outcomes			
		acquainted with ace		e series analysis. He g	gains the ability to work on con-
Course	S (type, r	number of weekly contact	nours, language — if other than (German)	
V (4) +					
Module	taugh	t in: English			
		sessment (type, scope, ble for bonus)	language — if other than Germa	n, examination offered — if r	not every semester, information on whether
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					
Allocat	ion of p	places			
Additio	nal inf	ormation			

Workload

300 h

Teaching cycle

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$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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Module appears in

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



Module title					Abbreviation	
Discre	te Math	iematics			10-M=VDIMin-152-m01	
Modul	e coord	inator		Module offered b	y	
Dean c	f Studi	es Mathematik (Matl	nematics)	Institute of Math	ematics	
ECTS	Metho	od of grading	Only after succ.	compl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequis	Other prerequisites		
1 seme	ster	graduate				
Conter	ıts					
		thods and results in or combinatorics)	a selected field of dis	crete mathematics (e.	g. coding theory, cryptography,	
Intend	ed lear	ning outcomes				
The stu	ıdent is	acquainted with ad	vanced results in a se	lected topic in discret	e mathematics.	
Course	S (type, r	number of weekly contact h	ours, language — if other tha	n German)		
V (3) + Modul		t in: English				
Metho	d of ass	SASSMANT (type scope)	anguage — if other than Ger	nan examination offered — it	f not every semester, information on wheth	

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whethe 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

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Additional information

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Workload

150 h

Teaching cycle

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$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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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)

Master's degree (1 major) Quantum Engineering (2024)

Master's degree (1 major) Physics International (2024)



Module title Abbreviation							
Dynami	Dynamical Systems				10-M=VDSYin-152-m01		
Module	coordi	nator		Module offered by			
Dean of	Studie	es Mathematik (Math	nematics)	Institute of Mathen	natics		
ECTS	Metho	d of grading	Only after succ. con	npl. of module(s)			
5	numer	ical grade					
Duration	n	Module level	Other prerequisites	i			
1 semes	ster	graduate					
Content	is						
Fundam	entals	of dynamical syster	ns, e. g. stability theory, e	ergodic theory, Hami	iltonian systems.		
Intende	d learn	ing outcomes					
The stud	dent m	asters the mathema	tical methods in the theo	ry of dynamic syster	ns, and is able to analyse their		
Courses	type, n	umber of weekly contact h	ours, language — if other than Ge	rman)			
V (3) + Ü Module		in: English					
		essment (type, scope, la le for bonus)	anguage — if other than German,	examination offered — if no	ot every semester, information on whether		
(approx Assessn	. 15 mi nent of ge of a	nutes) or c) oral exam ffered: In the semest ssessment: English	to 90 minutes, usually c mination in groups (group er in which the course is	os of 2, approx. 10 m			
Allocati	on of p	laces					
Addition	nal info	ormation	,				
Workloa	ad						
150 h							
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	appea	rs 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					Abbreviation	
Aspects of Geometry					10-M=VGEOin-152-m01	
Module coordinator				Module offered by	Module offered by	
Dean of Studies Mathematik (Mathematics)			hematics)	Institute of Mathen	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. o	mpl. of module(s)		
5	nume	erical grade				
Duratio	on	Module level	Other prerequisit	tes		
1 semester graduate						
Contents						
In-depth discussion of a special type of geometry taking into account recent developments and interrelations						

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.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$

with other mathematical structures, e. g. topological geometries, diagram geometries.

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation		
Mathematical Continuum Mechanics					10-M=VKOMin-152-m01		
Module coordinator Mo			Module offered by	l			
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	graduate					
Conter	its						
Partial	differe	ntial equations and/or va	ariational methods in	the context of conti	nuum mechanics.		
Intend	ed lear	ning outcomes					
		nasters the mathematical application.	methods in mathem	atical continuum me	echanics and knows about their		
Course	S (type, 1	number of weekly contact hours,	language — if other than Ger	rman)			
V (3) + Module		t in: English					
		sessment (type, scope, langua ole for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether		
(appro	x. 15 m ment o age of a	inutes) or c) oral examina iffered: In the semester in issessment: English	ation in groups (group	os of 2, approx. 10 m			
Allocat	ion of	places					
Additio	nal inf	ormation					
Worklo	Workload						
150 h							
Teachi	ng cycl	e					

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

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 appears in



Modul	Module title				Abbreviation	
Mathematical Imaging					10-M=VMBVin-152-m01	
Module coordinator				Module offer	red by	
Dean	Dean of Studies Mathematik (Mathematics)			Institute of M	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ.	compl. of module	e(s)	
5	nume	rical grade				
Durati	Duration Module level		Other prerequis	Other prerequisites		
1 semester graduate						
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 (type, number of weekly contact hours, language - if other than German)

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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Module appears in

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

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



Modul	Module title				Abbreviation	
Select	Selected Topics in Mathematical Physics				10-M=VMPHin-152-mo1	
Module coordinator				Module	e offered by	
Dean	Dean of Studies Mathematik (Mathematics)			Institut	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ	. compl. of m	odule(s)	
10	nume	rical grade				
Durati	Duration Module level		Other prerequi	Other prerequisites		
1 semester graduate						
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)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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)

Master's degree (1 major) Physics International (2024)



Module title					Abbreviation	
Selected Topics in Control Theory					10-M=VTRTin-152-m01	
Modul	e coord	inator		Module offered by	y	
Dean o	of Studi	es Mathematik (Mat	hematics)	Institute of Mathe	matics	
ECTS	Meth	od of grading	Only after succ. c	ompl. of module(s)		
10	nume	rical grade				
Durati	on	Module level	Other prerequisit	Other prerequisites		
1 seme	ester	graduate				
Conte	nts					
	ed topio ar syste		linear control theory, e.	g. networked linear o	control systems, controllability of	
Intend	ed lear	ning 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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation	
Inverse Problems					10-M=VIPRin-152-m01	
Modul	e coord	inator		Module offered by		
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Meth	od of grading	Only after succ. con	mpl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts					
Linear operator equations, ill-posed problems, regularisation theory, Tikhonov regularisation, iterative regularisation methods, examples of ill-posed problems.						
Intended learning outcomes						
					he can apply regularisation me- th selected inverse problems.	

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

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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



Module title				Abbreviation		
Module Theory					10-M=VMTHin-152-m01	
Module	e coord	inator		Module offered by	l	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Basics in module theory: modules and module spaces, canonical decomposition and representations, simple, semi-simple and complex modules, module trees and their defibrations, distorsion theorems, reduction theorems.						
Intende	ed lear	ning outcomes				
The stu	The student masters mathematical methods in module theory and is able to analyse their quality.					
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	man)		

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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

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



Module	Module title Abbreviation						
Non-lir	near An	alysis			10-M=VNANin-152-m01		
Module coordinator				Module offered by			
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	its						
Metho	ds in no	onlinear analysis (e. g. to	pological methods, n	nonotony and variati	onal methods) with applications.		
Intend	ed learı	ning outcomes					
		acquainted with the conical problems.	cepts of non-linear a	nalysis, can compar	e them and assess their applica-		
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)			
V (3) + Module		t in: English					
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether		
(approx Assess Langua	x. 15 mi ment o	inutes) or c) oral examina ffered: In the semester ir ssessment: English	ition in groups (group	s of 2, approx. 10 m			
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
	_		,				
Worklo	ad						
150 h							
Teaching cycle							
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)			
Module	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)



Modul	e title		Abbreviation			
Optima	al Cont	rol			10-M=VOSTin-152-m01	
Module coordinator				Module offered by	I.	
Dean c	of Studi	es Mathematik (Mat	hematics)	Institute of Mathematics		
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
5	nume	rical grade				
Duratio	Duration Module level Other prere			S		
1 seme	1 semester graduate					
Conter	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)

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation
Networked Systems					10-M=VVSYin-152-m01
Modul	Module coordinator			Module offered by	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
	Contemporary topics in networked linear and non-linear dynamical systems (homogenous and non-homogenous systems); analysis of control-theoretical aspects (controllability, accessibility, etc.).				
Intend	ed lear	ning outcomes			
The stu	ident is	acquainted with advance	ced methods in the fi	eld of networked sys	tems. 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)

 $V(3) + \ddot{U}(1)$

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

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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

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



Modul	e title		Abbreviation		
Compl	ex Geo	metry			10-M=VKGEin-152-m01
Module coordinator				Module offered by	
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	Duration Module level Other prer				
1 semester graduate					
Conter	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 fied and is able to apply the fundamental proof methods independently.

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

 $V(4) + \ddot{U}(2)$

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

$\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

Module appears in

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

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



Module title					Abbreviation
Partial	Differe	ential Equations of M	10-M=VPDPin-152-m01		
Modul	e coord	linator		Module offere	d by
Dean c	of Studi	es Mathematik (Mat	hematics)	Institute of Ma	athematics
ECTS	Meth	od of grading	Only after suc	c. compl. of module(s)
10	nume	rical grade			
Duratio	on	Module level	Other prerequ	isites	
1 semester graduate					
Conter	nts				
	•	• • •			tion and wave equation as standa

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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)

Master's degree (1 major) Physics International (2024)



Module title					Abbreviation	
Pseudo Riemannian and Riemannian Geometry					10-M=VPRGin-152-m01	
Module coordinator				Мо	dule offered by	
Dean o	f Studi	es Mathematik (Ma	thematics)	Ins	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ	c. compl.	of module(s)	
10	nume	rical grade				
Duratio	on	Module level	Other prerequ	isites		
1 semester graduate						
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 (type, number of weekly contact hours, language — if other than German)

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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)

Master's degree (1 major) Physics International (2024)



Module title					Abbreviation	
Functional Analysis					10-M=AFANin-152-m01	
Module coordinator				Module offer	ed by	
Dean	of Studi	es Mathematik (Mat	hematics)	Institute of M	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ	. compl. of module	(s)	
10	nume	rical grade				
Durati	Duration Module level Other prerequis			sites		
1 semester graduate						
Conte	ntc	-				

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation	
Applied Differential Geometry					10-M=VADGin-152-m01	
Module	Module coordinator			Module offered by		
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisite	es		
1 seme	ster	graduate				
Conten	nts		•			
The mo	odule b	uilds on the topics co	vered in module 10-M=	ADGM and discusses	selected applications of differen	

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.

tial geometry, e.g. at the interface of control theory and mechanics (subriemannian geometry), in the smooth op-

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

timisation on manifolds or applications in physics.

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Modul	e title		Abbreviation		
Giovanni Prodi Lecture Selected Topics (Master)					10-M=VGPSin-152-m01
Modul	e coord	inator		Module offered by	
Dean o	of Studi	es Mathematik (Mathem	natics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Durati	Duration Module level Other prerequisi				
1 seme	1 semester graduate				
Canta	Contonto				

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)



Modul	e title		Abbreviation		
Giovan	nni Prod	li Lecture Advanced Topi		10-M=VGPAin-152-m01	
Module coordinator				Module offered by	
Dean c	of Studi	es Mathematik (Mathem	atics)	Institute of Mathematics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	Duration Module level Other prere			i	
1 seme	1 semester graduate				
Camban	Combonido				

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)



Module title					Abbreviation	
Giovar	Giovanni Prodi Lecture Modern Topics (Master)				10-M=VGPMin-152-m01	
Module coordinator				Module offe	ered by	
Dean	of Studi	es Mathematik (Mat	hematics)	Institute of	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ	. compl. of modul	le(s)	
10	nume	rical grade				
Duration Module level Other prerequisite		sites				
1 semester graduate						
Conto	ntc	-				

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.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$

 $V(4) + \ddot{U}(2)$

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

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Additional information

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Workload

300 h

Teaching cycle

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

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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) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)



Module title					Abbreviation
Geometric Complex Analysis					10-M=VGFTin-211-m01
Module coordinator				Module offered by	
Dean c	of Studi	es Mathematik (Mathem	atics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	Duration Module level Other prereq				
1 seme	1 semester graduate				
Contor	Contonte				

Advanced methods and results in geometric complex analysis (e.g. conformal maps, conformal Riemannian metrics, quasiconformal maps, harmonic functions, biholomorphic maps).

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in geometric complex analysis, is able classify these results within more general theories and knows about the connections of geometric complex analysis with other fields of mathematics.

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

 $V(4) + \ddot{U}(2)$

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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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



Module title					Abbreviation	
Selected Topics in Numerical and Applied Mathematics						10-M=VNAMin-211-m01
Module coordinator Module offe				Module offered by	l .	
Dean o	f Studi	es Mathematik (Matl	hematics)		Institute of Mathen	natics
ECTS	TS Method of grading Only after succ. co		ucc. com	compl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prered	quisites		
1 seme	ster	graduate				
Conter	its					
	In-depth discussion of a specialised topic in numerical or applied mathematics taking into account recent developments and interrelations with other mathematical concepts.					
Intended learning outcomes						
The str	The student is acquainted with advanced results in a selected tonic in numerical or applied mathematics, and is					

The student is acquainted with advanced results in a selected topic in numerical or applied mathematics, and is able to apply these to complex problems.

 $\textbf{Courses} \ (\textbf{type}, \, \textbf{number of weekly contact hours, language} - \textbf{if other than German})$

 $V(4) + \ddot{U}(2)$

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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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



Module title					Abbreviation
Cryptography/Coding Theory					10-M=VKRYin-211-m01
Module coordinator				Module offered by	
Dean o	of Studi	es Mathematik (Mather	natics)	Institute of Mathematics	
ECTS	Metho	ethod of grading Only after succ. co		npl. of module(s)	
10	nume	rical grade	grade		
Durati	Duration Module level		Other prerequisites		
1 seme	1 semester graduate				
Conto	ntc				

Error detection and error correction, linear codes, channel coding theorems of Shannon, classical and contemporary codes, bounds, network codes, connections to cryptography.

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in coding theory and cryptography, is able to classify these results within more general theories and knows about the connections of coding theory and cryptography with other fields of mathematics.

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

 $V(4) + \ddot{U}(2)$

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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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



Module title					Abbreviation	
Compu	iter Alg	ebra			10-M=VCALin-211-m01	
Modul	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Math	nematics)	cs) Institute of Mathematics		
ECTS	Meth	nod of grading Only after s		npl. of module(s)		
10	nume	nerical grade				
Duratio	Duration Module level		Other prerequisites	Other prerequisites		
1 seme	1 semester graduate					
Conter	Contents					

Fast multiplication of numbers, polynomials and matrices, fast chinese remainder theorem; factorisation of polynomials over finite fields; lattices, lattice basis reduction and LLL-algorithm; factorisation of rational polynomials, symbolic integration of rational functions; exact arithmetic with algebraic numbers; multivariate polynomials, Gröbner basis, Buchberger's algorithm, algorithms for permutation groups.

Intended learning outcomes

The student knows about the theoretical foundations and the possible applications of several methods in computer algebra.

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

 $V(4) + \ddot{U}(2)$

Module taught in: English

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language}) \ (\textbf{type}, \textbf{language}) \$ 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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

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 (2021)



Module title					Abbreviation	
Algorithmic Number Theory					10-M=VAZTin-211-m01	
Modul	e coord	inator		Module offered by	L	
Dean o	of Studi	es Mathematik (Mathem	atics)	Institute of Mathematics		
ECTS	Meth	lethod of grading Only after succ. o		npl. of module(s)		
10	nume	nerical grade				
Durati	Duration Module level		Other prerequisites			
1 seme	1 semester graduate					
Conto	Contonto					

Binary numbers, computation of the greatest common divisor, pseudoprime tests, computation of primitive roots. Primality tests for Fermat and Mersenne numbers, factorisation methods (Pollard-Rho, (p-1)-method, elliptic curve method, quadratic sieve method), discrete logarithm.

Intended learning outcomes

The student knows about the theoretical foundations and the possible applications of several methods in algorithmic number theory.

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

 $V(4) + \ddot{U}(2)$

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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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



Module title					Abbreviation
Algebraic Geometry					10-M=VAGEin-211-m01
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathemat			nematics)	Institute of Mathematics	
ECTS	Meth	ethod of grading Only after succ.		ompl. of module(s)	
10	nume	rical grade			
Duration Module level		Other prerequisit	Other prerequisites		
1 semester graduate					
Conte	ntc				

Affine and projective space, affine and projective varieties, morphisms and rational maps; function fields, divisors and Riemann-Roch theorem for curves; genus, singularities and Plücker formula; dual curve, dual surface; Bezout's theorem; Grassmann and flag varieties; 27 lines in a cubic surface.

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in algebraic geometry, is able to classify these results within more general theories and knows about the connections of algebraic geometry with other fields of mathematics.

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

 $V(4) + \ddot{U}(2)$

Module taught in: English

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language}) \ (\textbf{type}, \textbf{language}) \$ 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)

Language of assessment: English

Assessment offered: Only when announced in the semester in which the courses are offered and in the subsequent semester

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 (2021)

Master's degree (1 major) Mathematics International (2022)

exchange program Mathematics (2023)



Research in Groups and Seminars

(20-60 ECTS credits)



Modul	e title			Abbreviation		
Research in Groups - Algebra					10-M=GALGin-152-m01	
Modul	e coord	linator		Module offered by	l.	
Dean of Studies Mathematik (Mathema			hematics)	Institute of Mathematics		
ECTS Method of grading		Only after succ. co	Only after succ. compl. of module(s)			
10	numerical grade					
Duratio	on	Module level	Other prerequisites	3		
1 seme	ster	graduate				
Conten	ıts					
Intende The stu ques ir	ed lear Ident g	ning outcomes ains insight into con eld and can apply th	em to complex problems		She masters advanced techni-	
V (2) +	S (2)	number of weekly contact h	ours, language — if other than Ge	rman)		
		sessment (type, scope, l	anguage — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	o minutes) offered: In the semes assessment: English	ter in which the course is	offered and in the s	ubsequent semester	
Allocat	ion of	places				

Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation		
Resear	ch in G	roups - Discrete Mathen	natics		10-M=GDIMin-152-m01		
Modul	e coord	inator		Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS			Only after succ. con	npl. of module(s)			
10							
 		Other prerequisites					
1 semester graduate							
Conter	its		•				
Selecte	ed mod	ern topics in discrete ma	thematics.				
Intend	ed lear	ning outcomes					
		ains insight into contem es in this field and can ap			nematics. He/She masters advan-		
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)			
V (2) + Module		t in: English					
		sessment (type, scope, langualle for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether		
Assess	ment o	minutes) ffered: In the semester i ssessment: English	n which the course is	offered and in the su	ubsequent semester		
	ion of p						
	-						
Additio	onal inf	ormation					
Worklo	ad						
300 h			-				
Teachi	ng cycl	e					
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	ımmes)			
Modul	e appea	ars in					
	_	ee (1 major) Mathematic	_				
Master	Master's degree (1 major) Mathematics International (2021)						



itle	Abbreviation				
in Groups - Dynamical Syst	10-M=GDSCin-152-m01				
oordinator		Module offered by			
tudies Mathematik (Mathen	natics)	Institute of Mathem	natics		
lethod of grading	Only after succ. con	npl. of module(s)			
umerical grade					
Module level	Other prerequisites	her prerequisites			
er graduate					
,					
modern topics in dynamical	systems and control t	heory.			
learning outcomes					
type, number of weekly contact hours	, language — if other than Ger	rman)			
(2)					
o f assessment (type, scope, langu editable for bonus)	uage — if other than German, o	examination offered — if no	ot every semester, information on whether		
o 120 minutes) ent offered: In the semester of assessment: English	in which the course is	offered and in the su	ubsequent semester		
n of places					
•					
al information					
Workload 300 h					
cycle					
cycle					
cycle to in LPO I (examination regulation	ns for teaching-degree progra	ımmes)			
	ns for teaching-degree progra	ımmes)			
	ns for teaching-degree progra	ımmes)			
	modern topics in dynamical grade graduate modern topics in dynamical learning outcomes ent gains insight into contemers advanced techniques in type, number of weekly contact hours (2) aught in: English fassessment (type, scope, langueditable for bonus) on 120 minutes) ent offered: In the semester e of assessment: English in of places	nethod of grading Itudies Mathematik (Mathematics) Itethod of grading Itehod of grading I	Institute of Mathematics Institute of Mathemat		

Master's degree (1 major) Mathematics International (2021) Master's degree (1 major) Mathematics International (2022)



Modul	e title		Abbreviation		
Resea	ch in G	roups - Complex Ar	10-M=GCOAin-152-mo1		
Modul	e coord	inator		Module offe	red by
Dean c	f Studi	es Mathematik (Ma	thematics)	Institute of N	
ECTS Method of grading O		Only after succ.	Only after succ. compl. of module(s)		
10	nume	numerical grade			
Duratio	on	Module level	Other prerequisi	tes	
1 seme	ster	graduate			
Conter	ıts	,	·		
geome	tric cor		ex analysis (e. g. in app e distribution theory).	roximation theo	ry, potential theory, complex dynamics,
The stu	ıdent g	ains insight into co	ntemporary research pr pply them to complex p		ex analysis. He/She masters advanced
Course	S (type, r	number of weekly contact	hours, language — if other thar	n German)	
V (2) + Modul		t in: English			
		sessment (type, scope, ble for bonus)	language — if other than Germ	an, examination offer	$\operatorname{\sf ed}-\operatorname{\sf if}$ not every semester, information on whether
Assess	ment o	o minutes) offered: In the seme ossessment: English		e is offered and i	n the subsequent semester
Alloca	tion of _I	places			

Additional information

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Workload

300 h

Teaching cycle

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

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Module appears in

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

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



Module title					Abbreviation	
Research in Groups - Geometry and Topology			ppology		10-M=GGMTin-152-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studie	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	ıpl. of module(s)		
10	nume	rical grade				
Duratio	Duration Module level Other prerequisites					
1 seme	ster	graduate				
Conten	its					
Selecte	ed mod	ern topics in geometry a	nd topology.			
Intend	ed learı	ning outcomes				
		ains insight into contemp ques in this field and ca			d topology. He/She masters ad-	
Course	S (type, n	umber of weekly contact hours,	language — if other than Ger	rman)		
V (2) +	S (2)					
Module	e taugh	t in: English				
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
			-			
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
			_			
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	e appea	rs in				
Master's degree (1 major) Mathematics International (2015)						
	master s degree (1 major) matricination at (2015)					



Modul	o titlo				Abbreviation	
		roups - Mathematics in	Context		10-M=GMCXin-152-mo1	
il Cocui			Context	1	10 M GMCAIII 132 IIIO1	
Modul	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mathen	natics	
ECTS Method of grading Only after succ		Only after succ. con	npl. of module(s)			
10	nume	merical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	ıts					
ven by	a histo		ic region or a particula	ar field of mathemat	of the history of mathematics, gi- ics. Other possibilities arise from a.	
Intend	ed lear	ning outcomes				
The stu	udent re	ealises the cultural dime	ension of mathematics	and its relation to o	ther cultural fields.	
Course	es (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (2) + Module		t in: English				
		sessment (type, scope, langule for bonus)	uage — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	o minutes) ffered: In the semester ssessment: English	in which the course is	offered and in the so	ubsequent semester	
Allocat	tion of _l	olaces				
Additio	onal inf	ormation				
Worklo	oad					
300 h						
Teachi	ng cycl	e				
	-					

Module appears in

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

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

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



Modul	e title				Abbreviation		
Resear	ch in G	roups - Mathematics ir	the Sciences		10-M=GMSCin-152-m01		
Modul	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mather	matics)	Institute of Mathem	natics		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)			
10	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	graduate	ie				
Conter	its		·				
A mod	ern topi	c in mathematics in th	e sciences.				
Intend	ed lear	ning outcomes					
		ains insight into conter nniques in this field an			in the sciences. He/She masters		
Course	S (type, r	number of weekly contact hour	s, language — if other than Ge	rman)			
V (2) + Module		t in: English					
		sessment (type, scope, lang le for bonus)	ruage — if other than German,	examination offered — if no	ot every semester, information on whether		
Assess	ment o	ominutes) ffered: In the semester ssessment: English	in which the course is	offered and in the su	ubsequent semester		
Allocat	-						
Additio	nal inf	ormation					
Worklo	ad						
300 h	1						
Teachi	ng cycl	е					
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	ammes)			
Modul	e appea	rs in					
Master	's degr	ee (1 major) Mathemati	cs International (2015)				
Master's degree (1 major) Mathematics International (2021)							



Module	title				Abbreviation	
Research in Groups - Measure and Integral					10-M=GMAlin-152-m01	
Module	coordi	nator		Module offered by		
Dean o	f Studie	es Mathematik (Mat	hematics)	Institute of Mathen	natics	
ECTS	S Method of grading Only after succ. cor		npl. of module(s)			
10	numer	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
functio transfo	ns and rmatior	Lebesgue integrals n rule), Lp spaces a		g. product measure	me and measure, measurable s (with Fubini's theorem and the cal spaces.	
		ning outcomes				
			ntemporary research probl s field and can apply them		integration theory. He/She ma- ns.	
Course	S (type, n	umber of weekly contact I	nours, language — if other than Ge	rman)		
V (2) + : Module		in: English				
		essment (type, scope, le for bonus)	language $-$ if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment of	minutes) ffered: In the semes ssessment: English	ster in which the course is	offered and in the s	ubsequent semester	
Allocat	ion of p	laces				
Additio	nal info	ormation			_	
Worklo	ad					

300 h

Teaching cycle

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

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Module appears in

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

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



Module title Abbreviation						
Resear	Research in Groups - Numerical Mathematics and Applied Analysis 10-M=GNMAin-152-mo1					
Module	coord	inator		Module offered by		
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio	Ouration Module level Other prerequisites					
1 seme	ster	graduate				
Conten	ts		,			
Selecte	d topic	s in numerical mathema	tics, applied analysis	or scientific compu	ting.	
Intende	ed learı	ning outcomes				
		ains insight into a conten ers advanced techniques			nathematics or applied analysis. lex problems.	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (2) +	S (2)					
Module	taugh	t in: English				
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
		minutes) ffered: In the semester in	which the course is	offered and in the su	ubseguent semester	
1		ssessment: English			'	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	appea	rs in				
	_	ee (1 major) Mathematics	_			
1	_	ee (1 major) Mathematics				
Master	Master's degree (1 major) Mathematics International (2022)					



Module title					Abbreviation	
Research in Groups - Robotics, Optimization and Control Theory 10-M=GROCin-152-r			10-M=GROCin-152-m01			
Modul	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	ıpl. of module(s)		
10	nume	rical grade				
Duratio	Duration Module level Other prerequisites					
1 seme	1 semester graduate					
Conter	nts					
Selecte	ed mod	ern topics in robotics, op	timisation and contro	ol theory.		
Intend	ed lear	ning outcomes				
		ains insight into contemp advanced techniques in t			imization and control theory. He/ problems.	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	man)		
V (2) + Module		t in: English				
Metho	d of ass	sessment (type, scope, langua	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
module i	s creditab	le for bonus)				
Assess	ment o	o minutes) ffered: In the semester ir ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	tion of p	olaces				
	-					
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
	-					
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Modul	e appea	ars in				
Master	's degr	ee (1 major) Mathematics	International (2015)			
Master	Master's degree (1 major) Mathematics International (2021)					



Module title Abbreviation					Abbreviation
Resear	ch in G	roups - Time Series Ar	nalysis		10-M=GTSAin-152-m01
Module	e coord	linator		Module offered by	
Dean o	f Studi	es Mathematik (Mathe	matics)	Institute of Mather	matics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duration Module level Other prerequisites					
1 seme	ster	graduate			
Conten	ts				
Selecte	ed mod	ern topics in time serie	es analysis.		
Intend	ed lear	ning outcomes	<u> </u>		
			mporary research probl apply them to complex		nalysis. He/She masters advan-
Course	S (type, i	number of weekly contact hou	rs, language — if other than Ge	rman)	
V (2) + Module	` '	it in: English			
Metho	d of as	sessment (type, scope, lan	guage — if other than German,	examination offered — if n	ot every semester, information on whether
module i	creditab	ole for bonus)			
Assess	ment o	o minutes) offered: In the semeste assessment: English	r in which the course is	offered and in the s	ubsequent semester
Allocat	ion of	places			
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	d to in	LPO I (examination regulat	ions for teaching-degree progra	ammes)	
Module	e appea	ars in			
vioaul	appea	di S III			



Module title Abbreviation					Abbreviation		
Resear	ch in G	roups - Statistics			10-M=GSTAin-152-m01		
Modul	e coord	inator		Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS Method of grading Only after succ			Only after succ. con	npl. of module(s)			
10	nume	rical grade					
Duration Module level Other prerequisites							
1 seme	ster	graduate					
Conter	its		,				
Selecte	ed mod	ern topics in statistics.					
Intend	ed lear	ning outcomes					
		ains insight into contemeld and can apply them			/She masters advanced techni-		
Course	S (type, 1	number of weekly contact hours,	language — if other than Ger	rman)			
V (2) + Module	` '	t in: English					
		sessment (type, scope, langu ole for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether		
Assess	ment o	o minutes) offered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester		
Allocat	ion of	places					
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
				_			
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	ımmes)			

Module appears in



Module title Abbreviation					Abbreviation	
Resear	ch in G	roups - Number Theory			10-M=GNTHin-152-m01	
Module	coord	inator		Module offered by		
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS Method of grading Only after succ.			Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duration Module level Other prerequisites						
1 seme	ster	graduate				
Conten	ts					
Selecte	d mod	ern topics in number the	ory (e. g. algebraic nu	mber theory, modul	ar forms, diophantine analysis).	
Intende	ed learr	ning outcomes				
		ains insight into contemp			. He/She masters advanced tech-	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (2) + Module		t in: English				
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module appears in						



Modul	e title				Abbreviation	
Resear	ch in G	roups - Control Theory o	f Quantum Mechanica	al Systems	10-M=GCQSin-152-m01	
Modul	e coord	inator		Module offered by	<u> </u>	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
10	nume	rical grade				
Duratio	Duration Module level Other prerequisites					
1 seme	1 semester graduate					
Conter	nts					
Selecte	ed mod	ern topics in control thec	ory of quantum mecha	anical systems.		
Intend	ed lear	ning outcomes				
		ains insight into contemp e masters advanced tech			y of quantum mechanical sy- o complex problems.	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	man)		
V (2) + Module		t in: English				
Metho	d of ass	sessment (type, scope, langua	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
module i	s creditab	le for bonus)				
Assess	ment o	o minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	tion of p	olaces				
	-					
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	е				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Modul	e appea	rs in				
Master	's degr	ee (1 major) Mathematics	International (2015)			
Master	Master's degree (1 major) Mathematics International (2021)					



Module title					Abbreviation
Research in Groups - Differential Geometry			metry		10-M=GDGEin-152-m01
Modul	e coord	inator		Module offered by	I.
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics
ECTS Method of grading Only after s		Only after succ. con	npl. of module(s)		
10	numerical grade				
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate			
Conter	its				
Selecte	ed mod	ern topics in differential	geometry.		
Intend	ed lear	ning outcomes			
		ains insight into contemes in this field and can ap			eometry. He/She masters advan-
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)	
V (2) + Modul		t in: English			
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether
Assess	ment o	o minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester
Allocat	ion of p	olaces			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teaching cycle					

Teaching cycle

 $\textbf{Referred to in LPO I} \ \ (\text{exam} \text{ination regulations for teaching-degree programmes})$

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Module appears in

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

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



Module title					Abbreviation
Resear	ch in G	roups - Deformation Qua	ntization		10-M=GDFQin-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS Method of grading Only after succ			Only after succ. con	ıpl. of module(s)	
10	nume	rical grade			
Duratio	uration Module level Other prerequisites				
1 seme	ster	graduate			
Conten	its				
Selecte	ed mod	ern topics in deformatior	quantization.		
Intende	ed learı	ning outcomes			
		ains insight into contemp nniques in this field and			Quantization. He/She masters
Course	S (type, n	umber of weekly contact hours,	language — if other than Ger	man)	
V (2) +		tin Fueliah			
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					
talk (60 Assess	o to 120 ment o	minutes) ffered: In the semester in	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua	o to 120 ment o age of a	minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess	o to 120 ment o age of a	minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat 	o to 120 ment o age of a	minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat 	o to 120 ment o age of a	o minutes) ffered: In the semester in ssessment: English olaces	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat 	o to 120 ment o age of a ion of p	o minutes) ffered: In the semester in ssessment: English olaces	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat Additio Worklo	o to 120 ment o age of a ion of p	o minutes) ffered: In the semester in ssessment: English olaces	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat Additio	o to 120 ment o age of a cion of p	o minutes) ffered: In the semester in ssessment: English places prmation	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat Additio Worklo 300 h	o to 120 ment o age of a cion of p	o minutes) ffered: In the semester in ssessment: English places prmation	n which the course is	offered and in the su	ubsequent semester
talk (60 Assess Langua Allocat Additio Worklo 300 h Teachin	o to 120 ment o age of a cion of p onal info	o minutes) ffered: In the semester in ssessment: English places prmation			ubsequent semester
talk (60 Assess Langua Allocat Additio Worklo 300 h Teachin	o to 120 ment o age of a cion of p onal info	o minutes) ffered: In the semester in ssessment: English places prmation			ubsequent semester
talk (60 Assess Langua Allocat Additio Worklo 300 h Teachin	o to 120 ment o age of a cion of p onal info onal onal cycle ed to in	o minutes) ffered: In the semester in ssessment: English places prmation E LPO I (examination regulation			ubsequent semester



Module title					Abbreviation	
Research in Groups - Non-linear Analysis					10-M=GNLAin-152-m01	
Module coordinator Module				Module offered by	I.	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts		•			
Selecte	d mod	ern topics in non-linear a	analysis.			
Intende	ed lear	ning outcomes				
		ains insight into contempes in this field and can ap			nalysis. He/She masters advan-	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	rman)		
V (2) + Module	` '	it in: English				
Metho	d of ass	sessment (type, scope, langua	age — if other than German, o	examination offered — if no	ot every semester, information on whether	
module is	creditab	ole for bonus)				
Assess	ment o	o minutes) offered: In the semester in ossessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	ion of _I	places				
			-			
Additio	nal inf	ormation				
Worklo	ad					
300 h	300 h					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	Module appears in					



Module	Module title Abbreviation				
Research in Groups - Operator Algebras 10-M=GOPAin-152-mo1					10-M=GOPAin-152-m01
Module	coord	inator		Module offered by	I.
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. com	ıpl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Selecte	d mod	ern topics in operator alg	gebras.		
Intende	ed lear	ning outcomes			
		ains insight into contemp this field and can apply t			ebras. He/She masters advanced
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) +	S (2)				
Module	taugh	t in: English			
		sessment (type, scope, langua ele for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether
Assess	ment o	ominutes) ffered: In the semester ir ssessment: English	n which the course is	offered and in the su	ubsequent semester
Allocat	1				
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in					
Master's degree (1 major) Mathematics International (2015)					
Master	Master's degree (1 major) Mathematics International (2021)				



Module title				Abbreviation		
Seminar in Applied Differential Geometry 10-M=SADGin-152-mo1					10-M=SADGin-152-m01	
Module coordinator Module offered by					,	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
A mode	rn topi	c in applied differential g	geometry.			
Intende	ed lear	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
S (2) Module	e taugh	t in: English				
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachir	ng cycl	e				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in						
Master'	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	Module title Abbreviation					
Seminar in Algebra 10-M=SALGin-152-m01					10-M=SALGin-152-m01	
Module coordinator Module offered by						
		es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS		od of grading	Only after succ. com			
5		rical grade		.pu or mounte(s)		
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten	its	0	Į.			
A mode	ern topi	ic in algebra.				
		ning outcomes	-			
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
S (2)						
Module	e taugh	t in: English				
		sessment (type, scope, langua vle for bonus)	ge — if other than German, e	examination offered — if no	et every semester, information on whether	
Assess	ment o	o minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	_					
Additio	nal inf	ormation	-			
Worklo	ad					
150 h			,			
Teachi	ng cycl	e				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in						
	Master's degree (1 major) Mathematics International (2015)					
Master	Master's degree (1 major) Mathematics International (2021)					



Module title					Abbreviation	
Semina	Seminar in Dynamical Systems and Control				10-M=SDSCin-152-m01	
Modul	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	its					
A mode	ern topi	c in dynamical systems	and control.			
Intend	ed lear	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)		
S (2) Module	e taugh	t in: English				
		Sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	-					
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
	Master's degree (1 major) Mathematics International (2015)					
Master	Master's degree (1 major) Mathematics International (2021)					



Modul	Module title Abbreviation					
Seminar in Complex Analysis 10-M=SCOAin-152-mo1					10-M=SCOAin-152-m01	
Module coordinator M				Module offered by		
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	its		•			
A mode	ern topi	ic in complex analysis.				
Intend	ed lear	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	rman)		
S (2) Module	e taugh	t in: English				
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	o minutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat						
Additio	onal inf	ormation	_			
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Modul	Module appears in					
Master	Master's degree (1 major) Mathematics International (2015)					
Master	Master's degree (1 major) Mathematics International (2021)					
Master's degree (1 major) Mathematics International (2021)						



Module title Abbreviation						
Seminar in Financial and Insurance Mathematics					10-M=SFIMin-152-m01	
Module coordinator Module offered					,	
Dean o	of Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts					
A mode	ern topi	c in financial and insura	nce mathematics.			
Intend	ed learı	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	es (type, n	number of weekly contact hours,	language — if other than Ger	man)		
S (2) Module	e taugh	t in: English				
		sessment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
Assess	ment o	minutes) ffered: In the semester ir ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	tion of p	olaces				
	-					
Additio	onal inf	ormation				
Worklo	oad					
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)					
NA 4	()) () ()					



Module title Abbreviation					Abbreviation	
Seminar in Geometry and Topology 10-M=SGTOin-152-mo1					10-M=SGTOin-152-m01	
Module coordinator Mod				Module offered by		
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
A mode	ern topi	c in geometry and topolo	gy.			
Intende	ed learr	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
S (2) Module	e taugh	t in: English				
		essment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in						
	Master's degree (1 major) Mathematics International (2015)					
	_	ee (1 major) Mathematics				
Master	Master's degree (1 major) Mathematics International (2022)					



Module	e title	Abbreviation		
Giovanni Prodi Seminar (Master)				10-M=SGPCin-152-m01
Module	e coordinator		Module offered by	
Dean o	f Studies Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Method of grading	Only after succ. compl. of module(s)		
5	numerical grade			

Duration Module level Other prerequisites 1 semester graduate

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)

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 (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) 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) Economathematics (2022)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's degree (1 major) Economathematics (2024)



Module title Abbro					Abbreviation	
Interdi	sciplina	ary Seminar			10-M=SIDCin-152-m01	
Module coordinator N				Module offered by	l.	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts		•			
A mode	ern topi	ic in mathematics with i	nterdisciplinary aspec	ts.		
Intend	ed lear	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)		
S (2) Module	e taugh	t in: English				
		sessment (type, scope, langu le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	o minutes) ffered: In the semester i ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces	,			
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Mathematics International (2015)						
Master	Master's degree (1 major) Mathematics International (2021)					



Module title Abbreviation					Abbreviation	
Seminar Mathematics in the Sciences 10-M=SMSCin-152-mo1					10-M=SMSCin-152-m01	
Module coordinator Module offered by						
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	its		•			
A mode	ern topi	ic in mathematics in the	sciences.			
Intend	ed learı	ning outcomes				
					omprehending and structuring of ate in a scientific discussion.	
Course	S (type, r	number of weekly contact hours,	language — if other than Gei	rman)		
S (2) Module	e taugh	t in: English				
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	n which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
			_			
Additio	nal inf	ormation				
Worklo	ad					
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)					
NA 4	Mantage design (a mail a) Mathematical International (a a a)					



Module title				Abbreviation	
Seminar in Numerical Mathematics and Applied Analysis 10-M=SNMAin-152-mo				10-M=SNMAin-152-m01	
Module coordinator Module offered by					
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
5	numei	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts		,		
A mode	rn topi	c in numerical mathemat	tics or applied analys	is.	
Intende	ed learr	ning outcomes			
					omprehending and structuring of ate in a scientific discussion.
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)	
S (2)					
Module	taugh	t in: English			
		essment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether
		minutes) ffered: In the semester ir	which the course is	offered and in the su	ubsequent semester
		ssessment: English			•
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
150 h					
Teachir	ng cycle	e			
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module appears in					
	_	ee (1 major) Mathematics			
	_	ee (1 major) Mathematics ee (1 major) Mathematics			



Module	Module title Abbreviation						
Semina	Seminar in Optimization				10-M=SOPTin-152-m01		
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS	T T			<u> </u>			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
A mode	ern topi	c in optimisation.					
Intende	ed learı	ning outcomes					
					omprehending and structuring of ate in a scientific discussion.		
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)			
S (2) Module	e taugh	t in: English					
		sessment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether		
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester		
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
150 h	150 h						
Teaching cycle							
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	Module appears in						
	Master's degree (1 major) Mathematics International (2015)						
	_	ee (1 major) Mathematics					
Master	Master's degree (1 major) Mathematics International (2022)						



Module	e title	Abbreviation					
Seminar in Statistics				_	10-M=SSTAin-152-m01		
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS	S Method of grading Only after succ. cor			pl. of module(s)			
5	numerical grade						
Duratio	Duration Module level Other prerequisites						
1 seme	ster	graduate					
Conten	ts						
A mode	ern topi	c in statistics.					
Intende	ed learı	ning outcomes					
				•	omprehending and structuring of ate in a scientific discussion.		
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)			
S (2) Module	e taugh	t in: English					
		eessment (type, scope, langua le for bonus)	ge — if other than German, ϵ	examination offered — if no	ot every semester, information on whether		
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester		
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
150 h	150 h						
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	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)						
Master	Master's degree (1 major) Mathematics International (2022)						



Module title					Abbreviation		
Semina	ar in No	n-linear Analysis		10-M=SNLAin-152-m01			
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS	S Method of grading Only after succ. co			pl. of module(s)			
5	numerical grade						
Duratio	Duration Module level Other prerequisites						
1 seme	ster	graduate					
Conten	ts						
A mode	ern topi	c in non-linear analysis.					
Intend	ed learı	ning outcomes					
				•	omprehending and structuring of ate in a scientific discussion.		
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)			
S (2) Module	e taugh	t in: English					
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether		
Assess	ment o	ominutes) ffered: In the semester in ssessment: English	which the course is	offered and in the su	ubsequent semester		
	ion of p						
Additio	nal inf	ormation					
Worklo	ad						
150 h	150 h						
Teaching cycle							
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	Module appears in						
	Master's degree (1 major) Mathematics International (2015)						
	Master's degree (1 major) Mathematics International (2021)						
Master	Master's degree (1 major) Mathematics International (2022)						



Module title Abbreviation							
Seminar in Applied Mathematics 10-M=SAMAin-211-m01							
Module coordinator Mo				Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Duration Module level Other prerequisites							
1 seme	ester	graduate					
Conter	ıts						
A mod	ern topi	ic in applied mathematic	S.				
		ning outcomes	-				
The stu	udent is	able to elaborate a cont			omprehending and structuring of ate in a scientific discussion.		
Course	es (type, r	number of weekly contact hours,	language — if other than Gei	man)			
S (2) Modul	e taugh	t in: English					
		sessment (type, scope, langua	ge — if other than German,	examination offered — if no	ot every semester, information on whether		
Langua Assess	age of a	•	nced in the semester	in which the course	es are offered and in the subse-		
Allocat	tion of p	olaces					
Additio	onal inf	ormation					
Worklo	oad						
150 h							
Teaching cycle							
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
Modul	Module appears in						
Master	r's degr	ee (1 major) Mathematics	s International (2021)				



Module	Module title Abbreviation						
Research in Groups - Lie Theory 10-M=GLIEin-211-m01							
Module coordinator Module o					offered by		
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathen	natics		
ECTS	Meth	od of grading	Only after succ. con	ıpl. of module(s)			
10	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
Selecte	d mod	ern topics in Lie Theory.					
Intende	ed lear	ning outcomes					
		ains insight into contempeld and can apply them t		ems in Lie Theory. H	e/She masters advanced techni-		
Course	S (type, r	number of weekly contact hours,	language — if other than Gei	man)			
V (2) + Module	` '	t in: English					
		sessment (type, scope, langua ble for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether		
Langua	ge of a		nced in the semester	in which the course	es are offered and in the subse-		
Allocat	ion of _l	places					
Additio	nal inf	ormation					
Workload							
300 h							
Teaching cycle							
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	appea	ars in					



ule offered by ute of Mathematics module(s)						
ute of Mathematics						
module(s)						
n Applied Differential Geometry. He/She manplex problems.						
tion offered $-$ if not every semester, information on whether						
ich the courses are offered and in the subse-						
300 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
1						



Module title					Abbreviation	
Research in Groups - Mathematical Physics 10-M=GMAPin-211-mo1						
Module coordinator Module offer					<u>.</u>	
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mather	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts		•			
Selecte	d mod	ern topics in Mathemati	cal Physics.			
Intende	ed lear	ning outcomes				
		ains insight into contem ques in this field and ca			al Physics. He/She masters ad-	
Course	S (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (2) + : Module		t in: English				
Method	d of ass	-	age — if other than German,	examination offered — if n	ot every semester, information on whether	
Langua	ge of a ment o	•	unced in the semester	in which the course	es are offered and in the subse-	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	ammes)		

Module appears in



Thesis

(30 ECTS credits)



Module title					Abbreviation	
Master Thesis Mathematics International					10-M=MAMI-152-m01	
Modul	Module coordinator Module offered by					
Dean o	Dean of Studies Mathematik (Mathematics)			Institute of Mathematics		
ECTS	CTS Method of grading Only after succ. co			npl. of module(s)		
30	numerical grade					
Duration Module level		Other prerequisites				
1 semester graduate						

Contents

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

No courses assigned to module

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

Master's thesis (750 to 900 hours total)

Registration and assignment of topic in consultation with supervisor.

Language of assessment: English

Allocation of places

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Additional information

Time to complete: 6 months.

Workload

900 h

Teaching cycle

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

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Module appears in

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

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