

Module Catalogue

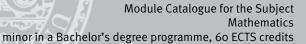
for the Subject

Mathematics

as a minor in a Bachelor's degree programme (60 ECTS credits)

Examination regulations version: 2008 Responsible: Institute of Mathematics

JMU Würzburg • generated 23-Aug-2021 • exam. reg. data record B1|105|-|-|N|2008





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The subject is divided into

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Content and Objectives of the Programme

Julius-Maxi

UNIVERSITÄT

WÜRZBURG

The Bachelor programme in Mathematics as Subsidiary Subject is offered by the Department of Mathematics, with a total of currently (SS 2010) 9 chairs.

At the end of this course of study, the student should be familiar with the basics of mathematics, taught methods of mathematical reasoning and working as well as analytical thinking, abstract concepts and the ability to recognize and construct complex structures and interconnections.

The main emphasis is put on basic mathematical knowledge, method knowledge and the development of the mental constructs which are typical for mathematics. The acquisition of special topics in different secondary branches of mathematics is subordinate.



Abbreviations used

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

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

Methods of grading: **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:

ASPO2007

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

19-Mar-2009 (2008-43)

24-Mar-2010 (2010-12)

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 Courses

(34 ECTS credits)

	Module title				Abbreviation
Propa	edeutic	s of Mathematics			10-M-PPM-082-m01
Modu	le coord	linator		Module offered by	
Dean	of Studi	es Mathematik (Mathem	atics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
2	(not)	successfully completed			
Durat	ion	Module level	Other prerequisites	i	
1 sem	ester	undergraduate		site to assessment: inning of the course	regular attendance of courses (as).
Conte	nts		•		
thema	atics, e.	g. by reference to its hist			les of abstract concepts of ma- ic and deduction.
Inten	ded lear	ning outcomes			
				d techniques in mat	hematics. He/She is able to per-
oral fo		thematical arguments ind	dependently and pres	sent them adequate	y and reasonably in written and
oral fo	orm.	number of weekly contact hours,		·	
oral for Cours	orm.		language — if other than Ge	rman)	ly and reasonably in written and
oral for Cours V + Ü Metho	orm. es (type, to (no info od of as	number of weekly contact hours, rmation on SWS (weekly	language — if other than Ge contact hours) and co	rman) ourse language avai	ly and reasonably in written and
oral for Cours V + Ü Metho module project Asses	es (type, (no info od of as is credital ct assign	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus)	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester	rman) ourse language avai examination offered — if n ecified by the lecture	ly and reasonably in written and lable)
oral fo Cours V + Ü Metho module project Assess Langu	es (type, (no info od of as is credital ct assign	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus) nments (type and expend offered: once a year, winto assessment: German, Eng	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester	rman) ourse language avai examination offered — if n ecified by the lecture	ly and reasonably in written and lable) ot every semester, information on whether
oral fo Cours V + Ü Metho projec Asses Langu	orm. es (type, i (no info od of as: is credital ct assign sment c iage of a	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus) nments (type and expend offered: once a year, winto assessment: German, Eng	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester	rman) ourse language avai examination offered — if n ecified by the lecture	ly and reasonably in written and lable) ot every semester, information on whether
oral fo Cours V + Ü Metho module projec Asses Langu Alloca	orm. es (type, i (no info od of as: is credital ct assign ssment c iage of a ation of	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus) nments (type and expend offered: once a year, winto assessment: German, Eng	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester	rman) ourse language avai examination offered — if n ecified by the lecture	ly and reasonably in written and lable) ot every semester, information on whether
oral fo Cours V + Ü Metho module projec Asses Langu Alloca	orm. es (type, i (no info od of as: is credital ct assign ssment c iage of a ation of	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus) nments (type and expend offered: once a year, winto assessment: German, Eng places	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester	rman) ourse language avai examination offered — if n ecified by the lecture	ly and reasonably in written and lable) ot every semester, information on whether
oral fo Cours V + Ü Metho module projec Asses Langu Alloca Additi	orm. es (type, i (no info od of as is credital ct assign sment c iage of a ation of ional inf	number of weekly contact hours, rmation on SWS (weekly sessment (type, scope, langua ole for bonus) nments (type and expend offered: once a year, winto assessment: German, Eng places	language — if other than Ge contact hours) and co age — if other than German, iture of time to be sp er semester glish if agreed upon w	rman) ourse language avail examination offered — if no ecified by the lecture vith the examiner	ly and reasonably in written and lable) ot every semester, information on whether

Module	e title				Abbreviation
Analysis					10-M-ANA-082-m01
Module coordinator				Module offered by	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics
ECTS	Methe	od of grading	Only after succ. con	npl. of module(s)	
17 numerical grade					
Duratio	on	Module level	Other prerequisites		
2 seme	ester	undergraduate	By way of exception, additional prerequisites are listed in the section on assessments.		
Conten	Its	~	-		
Real numbers and completeness, basic topological notions, convergence and divergence of sequences and series, power series, Taylor series, fundamental calculus in one and several variables (including inverse and implicit function theorem); fundamental integral calculus in one variable (Riemann integral and improper integrals). Intended learning outcomes					
Theat	donth	nows and mastars the as	contial mathada and	nations of analysis	110/Chaicable to norform and

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

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

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

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

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

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

Assessment in module component 10-M-ANA-1-082: Analysis 1 Analysis 1

- 8 ECTS, Method of grading: (not) successfully completed
- a) written examination (approx. 90 minutes; usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Modules 10-M-VKM and 10-M-PPM are recommended.

Assessment in module component 10-M-ANA-2-082: Analysis 2 Analysis 2

- 7 ECTS, Method of grading: (not) successfully completed
- a) written examination (approx. 90 minutes; usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Modules 10-M-VKM and 10-M-PPM are recommended; in addition, module component 10-M-ANA-1 is recommended for module component 10-M-ANA-2.
- Assessment in module component 10-M-ANA-P-082: Examination in Analysis
 - 2 ECTS, Method of grading: numerical grade
 - oral examination of one candidate each (approx. 30 minutes)
 - Language of assessment: German, English if agreed upon with the examiner
 - Only after successful completion of module components: Successful completion of any one of the module components 10-M-ANA-1, 10-M-ANL-1, 10-M-ANA-2, 10-M-ANL-2 is a prerequisite for participation in module component 10-M-ANA-P.

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Allocation of places

Additional information

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

§ 73 (1) 1. Mathematik Analysis

Module	e title				Abbreviation
Linear	Linear Algebra			10-M-LNA-082-m01	
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathematics)		atics)	s) Institute of Mathematics		
ECTS Method of grading Only after su		Only after succ. con	npl. of module(s)		
14 numerical grade					
Duratio	on	Module level	Other prerequisites		
2 seme	ster	undergraduate	By way of exception, additional prerequisites are listed in the section on assessments.		

Contents

Sets, relations and maps; notions of groups, rings and fields (in particular, polynomial rings); vector spaces (subspaces, quotient spaces, linear independency, basis, dimension); linear maps (isomorphism theorem, image, kernel, rank); matrix calculus; systems of linear equations, determinants, eigenvalues, eigenvectors and eigenspaces, diagonalisability (including characteristic polynomial, minimal polynomial), normal forms, bilinear forms; Euclidean and unitary vector spaces (orthonormal bases, isometries, principal axis transformation).

Intended learning outcomes

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

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

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

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

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

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

Assessment in module component 10-M-LNA-1-082: Linear Algebra 1 Linear Algebra 1

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

Assessment in module component 10-M-LNA-2-082: Linear Algebra 2 Linear Algebra 2

- 5 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner

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

Assessment in module component 10-M-LNA-P-082: Examination in Linear Algebra

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

Allocation of places

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Additional information

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

Modul	e title			Abbreviation	
Prepai	Preparatory Course Mathematics				10-M-VKM-082-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	npl. of module(s)	
1	(not)	successfully completed			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate	Admission prerequi specified at the beg		regular attendance of courses (as).
Conte	nts				
Introd	uction t	o the basic techniques in	mathematics; appro	ach to sets, proposi	tions, propositional logic.
Intend	ed lear	ning outcomes			
	-	ets acquainted with the b s degree study programm	-	ues which are prere	quisites for the further courses in
Course	es (type, r	number of weekly contact hours,	language — if other than Ger	rman)	
V + Ü (no info	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
		sessment (type, scope, langua ble for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether
project assignments (type and expenditure of time to be specified by the lecturer at the beginning of the course) Assessment offered: once a year, winter semester Language of assessment: German, English if agreed upon with the examiner					
Alloca	tion of _l	places			
Additional information					
Referr	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)	



Compulsory Electives

(26 ECTS credits)

Module title Abbreviation				
Ordinary D	ifferential Equations			10-M-ODE-082-m01
Module coordinator			Module offered by	•
Dean of Stu	ıdies Mathematik (Mathem	atics)	Institute of Mathen	natics
ECTS Me	thod of grading	Only after succ. con	npl. of module(s)	
5 nui	merical grade			
Duration	Module level	Other prerequisites		
1 semester	undergraduate	graduate Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective deta at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment of the course of the semester, the lecturer will put their registration for sessment into effect. Students who meet all prerequisites will be add ted to assessment in the current or in the subsequent semester. For sessment at a later date, students will have to obtain the qualification admission to assessment anew.		
Contents				
	nd uniqueness theorem, co juations, matrix exponentia			tial values, systems of linear dif- igher order.
Intended le	arning outcomes			
	t is acquainted with the fun He/she is able to apply the			heory of ordinary differential
Courses (typ	e, number of weekly contact hours,	language — if other than Ger	rman)	
V + Ü (no ir	formation on SWS (weekly	contact hours) and co	ourse language avail	lable)
	assessment (type, scope, langua itable for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner				
Allocation of places				
Additional	information			
Referred to	in LPO I (examination regulation	is for teaching-degree progra	mmes)	

Module title					Abbreviation
Semina	ar in An	alysis			10-M-BSA-072-m01
Module	e coord	inator		Module offered by	
Dean o	fStudie	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	undergraduate			
Conten	ts				
A selec	ted top	ic in analysis.			
Intende	ed learı	ning outcomes			
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
S (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	<u>)</u>
		s essment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
talk (approx. 60 minutes) Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner					
Allocat	ion of p	olaces			
Additional information					
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
§ 73 (1)	§ 73 (1) 1. Mathematik Analysis				

Module title					Abbreviation
Semina	ar in Lir	iear Algebra			10-M-BSL-072-m01
Module	e coord	inator		Module offered by	
Dean o	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
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	undergraduate			
Conten	ts				
A selec	ted top	ic in linear algebra.			
Intende	ed leari	ning outcomes			
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
S (no ir	format	ion on SWS (weekly cont	act hours) and cours	e language available	(د
		s essment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether
Assess	talk (approx. 60 minutes) Assessment offered: in the semester in which the course is offered Language of assessment: German, English if agreed upon with the examiner				
Allocat	ion of p	olaces			
Additional information					
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	
§ 73 (1)	§ 73 (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie				

Module title					Abbreviation	
Semin	Seminar in Algebra				10-M-BSE-072-m01	
Modul	e coord	linator		Module offered by		
Dean o	of Studi	es Mathematik (Mathen	natics)	Institute of Mathem	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Durati	on	Module level	Other prerequisites	i		
1 seme	ester	undergraduate				
Conter	nts					
A sele	cted top	oic in algebra.				
Intend	ed lear	ning outcomes				
of a giv ly in a	ven top scientif		ure, and prepares a tal	k on the subject. He	sters elaboration and structuring /She is able to participate active-	
		tion on SWS (weekly cor			e)	
Metho	d of as	· · · · · · · · · · · · · · · · · · ·		<u> </u>	ot every semester, information on whether	
Assess	sment o	60 minutes) offered: in the semester ussessment: German, En				
Alloca	tion of	places				
Additi	Additional information					
Referr	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
8 72 (1) 2. Mat	thematik Lineare Algebr	a. Algebra und Flemer	te der Zahlentheorie		

Module title					Abbreviation	
Semina	ar in Ge	ometry			10-M-BSG-072-m01	
Module	e coord	inator		Module offered by		
Dean o	fStudi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
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	undergraduate				
Conten	ts					
A selec	ted top	ic in geometry or differer	ntial geometry.			
Intende	ed lear	ning outcomes				
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-	
Course	S (type, r	umber of weekly contact hours, l	anguage — if other than Ger	rman)		
S (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	2)	
		s essment (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	50 minutes) ffered: in the semester ir ssessment: German, Eng				
Allocat	ion of p	olaces				
Additional information						
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		
§ 73 (1)	§ 73 (1) 4. Mathematik Geometrie					

Module title					Abbreviation	
Semina	ar in Nu	mber Theory		10-M-BSZ-072-m01		
Module	e coord	inator		Module offered by		
Dean o	fStudi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
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	undergraduate				
Conten	ts					
A selec	ted top	ic in number theory.				
Intende	ed learı	ning outcomes				
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-	
Course	S (type, n	umber of weekly contact hours, I	anguage — if other than Ger	rman)		
S (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	(د	
		s essment (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	50 minutes) ffered: in the semester ir ssessment: German, Eng				
Allocat	ion of p	olaces				
Additional information						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
§ 73 (1)	§ 73 (1) 2. Mathematik Lineare Algebra, Algebra und Elemente der Zahlentheorie					

Module title Abbreviation						
Semina	Seminar in Ordinary Differential Equations 10-M-BSW-072-m01					
Module	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	undergraduate				
Conten	ts					
A selec	ted top	oic in the theory of ordina	ary differential equation	ons.		
Intende	ed lear	ning outcomes				
of a giv ly in a s	en topi scientif		re, and prepares a tal	k on the subject. He	sters elaboration and structuring /She is able to participate active-	
		tion on SWS (weekly con			a)	
Method	d of ass		· · · · · · · · · · · · · · · · · · ·		ot every semester, information on whether	
Assess	ment o	50 minutes) ffered: in the semester in ssessment: German, Eng				
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
§ 73 (1) 1. Mathematik Analysis						

Module title					Abbreviation	
Semina	Seminar in Complex Analysis				10-M-BSC-072-m01	
Module	e coord	inator		Module offered by		
Dean o	fStudi	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	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
A selec	ted top	ic in complex analysis.				
Intende	ed leari	ning outcomes				
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
S (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	2)	
		s 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	50 minutes) ffered: in the semester ir ssessment: German, Eng				
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
§ 73 (1) 1. Mathematik Analysis						

Module title Abbreviation					Abbreviation	
Seminar in Numerical Mathematics					10-M-BSN-072-m01	
Modul	e coord	inator		Module offered by		
Dean o	of 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	on	Module level	Other prerequisites			
1 seme	ester	undergraduate				
Conter	nts					
A selec	ted top	oic in numerical mathema	atics.			
Intend	ed lear	ning outcomes				
of a giv ly in a s	ven top scientif	•	re, and prepares a tal	k on the subject. He	sters elaboration and structuring /She is able to participate active-	
	_	tion on SWS (weekly con			2)	
		sessment (type, scope, langua	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	sment o	60 minutes) ffered: in the semester in ssessment: German, Eng				
Allocat	tion of	places	· · · · · · · · · · · · · · · · · · ·			
Additio	Additional information					
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
§ 73 (1)) 5. Mat	hematik Angewandte Ma	athematik			

Module title					Abbreviation	
Seminar in Stochastics					10-M-BSS-072-m01	
Module	e coord	inator		Module offered by		
Dean o	fStudie	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	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
A selec	ted top	ic in stochastics.				
Intende	ed leari	ning outcomes				
of a giv	en topi	•	•	-	sters elaboration and structuring /She is able to participate active-	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
S (no ir	format	ion on SWS (weekly cont	act hours) and cours	e language available	<u>)</u>	
		s 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	50 minutes) ffered: in the semester ir ssessment: German, Eng				
Allocat	ion of p	olaces				
Additional information						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
§ 73 (1)	§ 73 (1) 3. Mathematik Stochastik					

Module title Abbreviation						
Seminar in Functional Analysis 10-M-BSF-072-m01						
Module	e coord	inator		Module offered by		
Dean o	of Studio	es Mathematik (Mathe	matics)	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	i		
1 seme	ster	undergraduate				
Conten	Its					
A selec	ted top	oic in functional analys	is.			
Intend	ed lear	ning outcomes				
of a giv ly in a s	ven topi scientif	ic using selected litera ic discussion.	ture, and prepares a ta	k on the subject. He	sters elaboration and structuring /She is able to participate active-	
	-		rs, language — if other than Ge			
-			ontact hours) and cours	<u> </u>		
		sessment (type, scope, lan le for bonus)	guage — if other than German,	examination offered — if no	ot every semester, information on whether	
talk (ap	oprox. 6	60 minutes)				
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						

Module title Abbreviation							
Seminar in Operation Research 10-M-BSO-072-m01							
Module	e coord	inator		Module offered by			
Dean o	fStudi	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	i			
1 seme	ster	undergraduate					
Conten	Its						
A selec	ted top	ic in operations researcl	1.				
Intend	ed lear	ning outcomes					
of a giv ly in a s	ven topi scientif	c using selected literatu ic discussion.	re, and prepares a tal	k on the subject. He	sters elaboration and structuring /She is able to participate active-		
	-	number of weekly contact hours,					
S (no ir	nformat	ion on SWS (weekly con	tact hours) and cours	e language available	e)		
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether		
talk (ap	oprox. 6	60 minutes)					
Allocat	ion of p	olaces					
Additio	Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)							

Module title Abbreviation						
Seminar in Discrete Mathematics 10-M-BSD-072-m01						
Module	e coord	inator		Module offered by		
Dean o	fStudi	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	undergraduate				
Conten	ts					
A selec	ted top	ic in discrete mathemati	cs.			
Intend	ed lear	ning outcomes				
of a giv	en topi				sters elaboration and structuring /She is able to participate active-	
Course	S (type, r	umber of weekly contact hours, l	anguage — if other than Ger	rman)		
S (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	2)	
		essment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
talk (ap	prox. 6	60 minutes)				
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						

Module title Abbreviation					
Introduction to Discrete Mathematics 10-M-EDM-072-mo1					
Module coordinator Module					/
Dean	of Studi	ies Mathematik (Mat	nematics)	Institute of Mathe	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
5	nume	erical grade			
Durati	ion	Module level	Other prerequisites	i	
sessmen at the be sidered a dents ha the cours sessmen ted to as		sessment. The lectu at the beginning of sidered a declaration dents have obtained the course of the se sessment into effect ted to assessment i	trer will inform stud the course. Registra on of will to seek ad d the qualification f mester, the lecture t. Students who me n the current or in t date, students will	ualify for admission to as- ents about the respective details ation for the course will be con- mission to assessment. If stu- for admission to assessment over r will put their registration for as- tet all prerequisites will be admit- he subsequent semester. For as- have to obtain the qualification fo	
	iques fr		ntroduction to graph theo	ry (including applic	ations), cryptographic methods,
		ng codes. rning outcomes			
The st levant	udent i t proof t	s acquainted with the echniques, is able to			ete mathematics, masters the re- ebra to discrete mathematics and
		· · ·	ours, language — if other than Ge	rman)	
V + Ü	(no info	rmation on SWS (we	ekly contact hours) and co	ourse language ava	ilable)
		sessment (type, scope, l ble for bonus)	anguage — if other than German,	examination offered — if	not every semester, information on whether
by an 2, app	oral exa prox. 30	amination of one can minutes)		ninutes) or an oral (itten examination can be replaced examination in groups (groups of
	ation of				
Additi	ional in	formation			
Refer	red to in	LPOI (examination regu	lations for teaching-degree progra	ammes)	
<u>§ 73 (</u>	1) 2. Ma	thematik Lineare Alg	ebra, Algebra und Elemer	nte der Zahlentheor	ie

Module title Abbreviation					
Introduction to Functional Analysis 10-M-FAN-072-m01					
Module coordinator		Module offered by			
Dean of Studies Mathematik (Mathem	natics)	Institute of Mathen	natics		
ECTS Method of grading	Only after succ. con	npl. of module(s)			
5 numerical grade					
Duration Module level	Other prerequisites				
1 semester undergraduate	Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as- sessment into effect. Students who meet all prerequisites will be admit- ted to assessment in the current or in the subsequent semester. For as- sessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Contents					
Banach spaces and Hilbert spaces, b	ounded operators, prin	nciples of functional	analysis.		
Intended learning outcomes					
The student knows the fundamental on methods, is able to apply methods fro broad applicability of the theory to ot	om linear algebra and	analysis to function			
Courses (type, number of weekly contact hours	, language — if other than Gei	rman)			
V + Ü (no information on SWS (weekly	contact hours) and co	ourse language avai	lable)		
Method of assessment (type, scope, langu nodule is creditable for bonus)	uage — if other than German,	examination offered — if no	ot every semester, information on whether		
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner					
Allocation of places					
Additional information					
<u>.</u>	_				
Referred to in LPO I (examination regulations for teaching-degree programmes)					

§ 73 (1) 1. Mathematik Analysis

Module title Abbreviation						
Operations Research 10-M-ORS-072-m01					10-M-ORS-072-m01	
Modul	e coord	inator		Module offered by	<u> </u>	
Dean o	of Studi	es Mathematik (Mathem	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 semester undergraduate		Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as- sessment into effect. Students who meet all prerequisites will be admit- ted to assessment in the current or in the subsequent semester. For as- sessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Conter	nts					
Linear	prograi	nming, duality theory, tr	ansport problems, int	egral linear program	ming, graph theoretic problems.	
Intend	ed lear	ning outcomes				
for solv	ving ma		specially in economic		h, as required as a central tool apply these methods to practical	
Course	es (type, i	number of weekly contact hours,	language — if other than Ger	rman)		
V + Ü (no info	rmation on SWS (weekly	contact hours) and co	ourse language avai	lable)	
		sessment (type, scope, languable for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner						
Allocation of places						
Additional information						
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		

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

§ 73 (1) 5. Mathematik Angewandte Mathematik

Module title					Abbreviation	
Introdu	Introduction to Number Theory 10-M-EZT-072-mo1					
Module	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	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
me test	ts and i		, structure of the resi	due class rings, theo	ation, modular arithmetics, pri- ory of quadratic remainder, qua-	
Intende	ed lear	ning outcomes				
		acquainted with the fun hese methods to practic	•		entary number theory. He/She is	
Course	S (type, r	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V + Ü (r	no infoi	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		s essment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
		mination (90 minutes; us nination in groups (group		ral examination of o	ne candidate each (20 minutes)	
Allocation of places						
Additional information						
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		

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Module title Abbreviation					
Non-Linear Dynamics 10-M-NLD-072-m01					
Module coordinator		Module offered by			
Dean of Studies Mathematik (Mathem	atics)	Institute of Mathen	natics		
ECTS Method of grading	Only after succ. con	pl. of module(s)			
5 numerical grade					
Duration Module level	Other prerequisites				
1 semester undergraduate	Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as- sessment into effect. Students who meet all prerequisites will be admit- ted to assessment in the current or in the subsequent semester. For as- sessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Contents					
Basic notions in stability theory, Lyap dixson, chaotic dynamics; application					
Intended learning outcomes					
The student is acquainted with the fur thods. He/She is able to apply these r					
Courses (type, number of weekly contact hours,	language — if other than Ger	man)			
V + Ü (no information on SWS (weekly	contact hours) and co	ourse language avai	lable)		
Method of assessment (type, scope, langu module is creditable for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether		
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner					
Allocation of places					
Additional information					
Referred to in LPO I (examination regulation	ns for teaching-degree progra	mmes)			

§ 73 (1) 1. Mathematik Analysis

Modul	e title				Abbreviation
Computational Mathematics, advanced 10-M-COMg-082-mo1					
Modul	e coord	linator		Module offered by	/
Dean c	of Studi	es Mathematik (Mathem	atics)	Institute of Mathe	matics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
4	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			: regular attendance of exercises one incident of unexcused ab-
Conter	nts	• •	• •		
10-M-A lar diff	NL and erentia	l 10-M-LNA). Computer-ba l and integral calculus; v	ased solution of prob	lems in linear algeb	is and linear algebra (10-M-ANA, ora, geometry, analysis, in particu
Intend	ed lear	ning outcomes			
		earns the use of advance cation to solve mathema		cal software packa	ges, and is able to assess their
Course	es (type,	number of weekly contact hours,	language — if other than Gei	rman)	
Ü + V (no info	rmation on SWS (weekly	contact hours) and co	ourse language ava	ilable)
		sessment (type, scope, langua ole for bonus)	age — if other than German,	examination offered — if	not every semester, information on whether
beginn Assess	ing of t ment c	form of programming exe he course) offered: once a year, sum ossessment: German, Eng	mer semester		be specified by the lecturer at the
. 0	tion of	places			
Allocat					
Allocat		ormation			
Allocat		ormation			
Allocat Additio 	onal inf	ormation LPO I (examination regulation	s for teaching-degree progra	mmes)	

Module title					Abbreviation	
Introdu	uction t	o Geometry			10-M-GEO-082-m01	
Module coordinator				Module offered by		
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathematics		
ECTS	Meth	od of grading	Only after succ. con	fter succ. compl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 semester undergraduate		By way of exception, additional prerequisites are listed in the section on assessments.				

Contents

Introduction to topics in geometry: axiomatic introduction of projective spaces, coordinates, fundamental theorems, relations to linear algebra and algebra, curves and hypersurfaces in Euclidean spaces, curvature.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of geometry.

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

This module has 2 components; information on courses listed separately for each component.

- 10-M-GEO-1-082: V + Ü (no information on language and number of weekly contact hours available)
- 10-M-GEO-2-082: V + Ü (no information on language and number of weekly contact hours available)

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

This module has the following 2 assessment components. To pass the module as a whole students must pass one of the two assessment components.

Assessment component to module component 10-M-GEO-1-082: Einführung in die Projektive Geometrie

- 8 ECTS credits, method of grading: numerical grade
- written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: English, German if agreed upon with the examiner
- Other prerequisites: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Assessment component to module component 10-M-GEO-2-082: Einführung in die Differentialgeometrie

- 8 ECTS credits, method of grading: numerical grade
- written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: English, German if agreed upon with the examiner
- Other prerequisites: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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Allocation of places

Additional information

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

§ 73 (1) 4. Mathematik Geometrie

minor in a Bachelor's degree programme Mathematics (2008)

Module title					Abbreviation	
Progra	Programming course for students of Mathematics and other subjects, simple 10-M-PRGk-082-mo1					
Modul	e coord	linator		Module offered by		
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
2	(not)	successfully completed				
Durati	on	Module level	Other prerequisites			
1 seme	ester	undergraduate			regular attendance (attendance of unexcused absence).	
Conte	nts					
Basics matics		odern programming langı	uage (e. g. C or Fortra	n) taking into accou	nt the particular needs in mathe-	
Intend	ed lear	ning outcomes				
	udent is hematio	•	ntly on small progran	nming exercises and	standard programming problems	
Course	es (type, r	number of weekly contact hours,	language — if other than Gei	rman)		
P (no i	nforma	tion on SWS (weekly cont	act hours) and cours	e language available	e)	
		s essment (type, scope, langua ble for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
project in the form of programming exercises (type and expenditure of time to be specified by the lecturer at the beginning of the course) Language of assessment: German, English if agreed upon with the examiner						
Allocation of places						
Additi	onal inf	ormation				
Referr	ed to in	LPOI (examination regulation	s for teaching-degree progra	immes)		
§ 73 (1) 5. Mat	thematik Angewandte Ma	athematik			

Module title					Abbreviation
Number Theory and Algebra					10-M-ZAL-082-m01
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathemat			atics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. compl. of module(s)		
13	nume	rical grade			
Duration Module level (Other prerequisites		
2 semester undergraduate		By way of exception, additional prerequisites are listed in the section on assessments.			

Contents

Introduction to number theory, algebra and their interrelations: basic algebraic structures (groups, rings, fields); discussion of properties of integers and rational numbers (as well as algebraic extensions) with regard to their algebraic structure (residue class rings and finite fields).

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of number theory and algebra. He/she is able to interrelate these concepts and realises the advantages of thinking across the borders of different branches in mathematics.

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

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

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

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

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

Assessment in module component 10-M-ZAL-1-082: Introduction to Number Theory Introduction to Number Theory

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

Assessment in module component 10-M-ZAL-2-082: Introduction to Algebra Introduction to Algebra

- 7 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for

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

Assessment in module component 10-M-ZAL-P-082: Examination in Number Theory and Algebra

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

Allocation of places

Additional information

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

Modul	Module title Abbreviation					
Numer	Numerical Mathematics 1 10-M-NM1-082-m01					
Modul	e coord	linator		Module offered by		
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 semester undergraduate		Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as- sessment into effect. Students who meet all prerequisites will be admit- ted to assessment in the current or in the subsequent semester. For as- sessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Conter	nts					
		stems of linear equations ition with polynomials, sp	U		quations and systems of equati- rical integration.	
Intend	ed lear	ning outcomes				
		s acquainted with the fun roblems and knows abou			erical mathematics, applies them	
Course	es (type, i	number of weekly contact hours, I	language — if other than Ger	rman)		
V + Ü (no info	rmation on SWS (weekly	contact hours) and co	ourse language avai	lable)	
		s essment (type, scope, langua ble for bonus)	ge — if other than German, o	examination offered — if n	ot every semester, information on whether	
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner						
Allocation of places						
Additio	onal inf	ormation				
Referred to in LPO I (examination regulations for teaching-degree programmes)						

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

§ 73 (1) 5. Mathematik Angewandte Mathematik

Module	Module title Abbreviation					
Stochas	stics 1				10-M-ST1-082-m01	
Module	coord	inator		Module offered by		
Dean of	f Studie	es Mathematik (Mathem	natics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes			lergraduate Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as sessment into effect. Students who meet all prerequisites will be admit ted to assessment in the current or in the subsequent semester. For as sessment at a later date, students will have to obtain the qualification admission to assessment anew.			
Conten	ts					
continu chastic	ious di: indepe	stributions: normal dist	ribution, random varia nditional probability,	ble, distribution fun characteristics of dis	asure and integration theory, ction, product measures and sto- stributions: expected value and	
Intende	ed learı	ning outcomes				
		acquainted with fundar lems and knows about t			ics, applies these methods to	
Courses	S (type, n	number of weekly contact hours,	language — if other than Ger	rman)		
V + Ü (n	no infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)						
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner						
Allocation of places						
Additio	nal inf	ormation				
Referre	d to in	LPOI (examination regulation	ns for teaching-degree progra	mmes)		

§ 73 (1) 3. Mathematik Stochastik

Module title					Abbreviation
Numer	ical Ma	thematics 2			10-M-NM2-082-m01
Module	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	npl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 semesterundergraduateCertain prerequisites must be met to qualify for admise sessment. The lecturer will inform students about the r at the beginning of the course. Registration for the cours sidered a declaration of will to seek admission to asse dents have obtained the qualification for admission to the course of the semester, the lecturer will put their re sessment into effect. Students who meet all prerequisi ted to assessment in the current or in the subsequent sessment at a later date, students will have to obtain the			nts about the respective details ion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- e subsequent semester. For as-		
Conter					
		ods and applications for ial equations, boundary v		s, linear programmin	g, initial value problems for ordi-
Intend	ed lear	ning outcomes			
about t	their ac		s concerning the poss		erical mathematics and knows on in different fields of natural
Course	es (type, 1	number of weekly contact hours,	language — if other than Ger	rman)	
V + Ü (I	no info	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
		sessment (type, scope, langua ole for bonus)	age — if other than German, o	examination offered — if no	t every semester, information on whether
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner					
Allocation of places					
Additio	onal inf	ormation			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)	
§ 73 (1) 5. Mathematik Angewandte Mathematik					

Module	e title				Abbreviation	
Stocha	stics 2				10-M-ST2-082-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
		Certain prerequisites must be met to qualify for admission to as- sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be con- sidered a declaration of will to seek admission to assessment. If stu- dents have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for as- sessment into effect. Students who meet all prerequisites will be admit- ted to assessment in the current or in the subsequent semester. For as- sessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Conten	Its					
Elemen	nts of d	ata analysis, statistics of	data in normal and c	other distributions, e	lements of multivariate statistics.	
Intende	ed lear	ning outcomes				
		acquainted with fundan and knows about the ty			, applies these methods to prac-	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	rman)		
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner						
Allocat	ion of _l	olaces				
Additio	onal inf	ormation				
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		
8 73 (1)	8 73 (1) 3 Mathematik Stochastik					

§ 73 (1) 3. Mathematik Stochastik

Module title					Abbreviation	
Progra	Programming course for students of Mathematics and other subjects 10-M-PRG-082-m01					
Module	e coord	inator	Module offered by	dule offered by		
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	ECTS Method of grading Only after succ. compl. of module(s)					
3	(not) s	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	undergraduate			regular attendance (attendance of unexcused absence).	
matics	•	odern programming langi ning outcomes	uage (e. g. C or Fortra	n) taking into accoui	nt the particular needs in mathe-	
The stu		able to work independe	ntly on small progran	nming exercises and	standard programming problems	
Course	S (type, r	number of weekly contact hours,	language — if other than Gei	man)		
P (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	e)	
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)						
project in the form of programming exercises (as specified at the beginning of the course) Language of assessment: German, English if agreed upon with the examiner						
Allocation of places						
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
§ 73 (1) 5. Mathematik Angewandte Mathematik						

Module	e title			Abbreviation		
Computeroriented Mathematics 10-M-COM-082-m01					10-M-COM-082-m01	
Module	e coord	inator		Module offered by		
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)		
3	(not) s	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate			regular attendance of exercises one incident of unexcused ab-	
Conten	ts					
lar diffe	erentia	d 10-M-LNA). Computer-b and integral calculus; vi ning outcomes			ora, geometry, analysis, in particu-	
The stu	ident le			cal software packag	es, and is able to assess their	
Course	S (type, r	number of weekly contact hours,	language — if other than Gei	rman)		
V + Ü (I	no info	mation on SWS (weekly	contact hours) and co	ourse language avai	lable)	
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess	ment o	form of programming exe ffered: once a year, sum ssessment: German, Eng	mer semester		he course)	
Allocation of places						
Additional information						
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)		

Module title				Abbreviation	
Ordinary Differential Equations and Complex Analysis					10-M-DFT-082-m01
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathemati			atics)	Institute of Mathematics	
ECTS	ECTS Method of grading Only after s		Only after succ. con	ter succ. compl. of module(s)	
13	nume	rical grade			
Duration Module level		Other prerequisites			
2 semester undergraduate		By way of exception, additional prerequisites are listed in the section on assessments.			
Contents					
Existence and uniqueness theorems on solutions of ordinary differential equations, solution theorems on sy- stems of linear differential equations, introduction to the problem of systems of nonlinear differential equati- ons, basic notions in the qualitative theory of ordinary differential equations, basic properties of holomorphic					

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

Intended learning outcomes

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

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

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

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

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

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

Assessment in module component 10-M-DFT-1-082: Ordinary Differential Equations Ordinary Differential Equations

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

Assessment in module component 10-M-DFT-2-082: Introduction to Complex Analysis Introduction to Complex Analysis

- 7 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)

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

Assessment in module component 10-M-DFT-P-082: Examination in Ordinary Differential Equations and Complex Analysis

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

Allocation of places

Additional information

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

§ 73 (1) 1. Mathematik Analysis

Module title					Abbreviation
Advanced Analysis 10-M-VAN-082-m01					10-M-VAN-082-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mather	natics
ECTS	Methe	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 semesterundergraduateCertain prerequisites must be met to qualify for adm sessment. The lecturer will inform students about th at the beginning of the course. Registration for the or sidered a declaration of will to seek admission to at dents have obtained the qualification for admission the course of the semester, the lecturer will put the sessment into effect. Students who meet all prereq ted to assessment in the current or in the subseque sessment at a later date, students will have to obta admission to assessment anew.			ents about the respective details tion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- ne subsequent semester. For as-		
Conten					
		gral in several variables ry Fourier theory in L^2,		on convergence and	Fubini's theorem, L^p-spaces
Intende	ed lear	ning outcomes			
		acquainted with advar understand the constru			e of the Lesbegue integral, he or
Course	S (type, r	number of weekly contact hours	, language — if other than Ge	rman)	
Ü + V (r	no info	rmation on SWS (weekly	/ contact hours) and co	ourse language avai	lable)
		sessment (type, scope, langu ole for bonus)	uage — if other than German,	examination offered — if n	ot every semester, information on whether
by an o 2, appr	oral exa rox. 30		ate each (approx. 20 r	ninutes) or an oral e	tten examination can be replaced xamination in groups (groups of
Allocat					
Additional information					
D - 6					

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

§ 73 (1) 1. Mathematik Analysis

Module title					Abbreviation	
Small Reading Course Mathematics 10-M-RCK-082-m01					10-M-RCK-082-m01	
Module	Module coordinator Module offered by					
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathematics		
ECTS Method of grading Only after succ.			Only after succ. con	compl. of module(s)		
1	(not) s	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Indepe	ndent s	study of a defined topic i	n mathematics.			
Intende	ed lear	ning outcomes				
		able to work independe se standard literature.	ntly on a given scient	ific topic. He or she	can tackle a simple mathematical	
Course	S (type, r	number of weekly contact hours, I	anguage — if other than Ger	man)		
A (no ir	nformat	tion on SWS (weekly cont	tact hours) and cours	e language available	<u>a)</u>	
Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)						
a) talk (approx. 30 minutes) or b) written elaboration (approx. 5 to 10 pages)						
Allocation of places						
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						