EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Mathematisch-
Naturwissenschaftliche
Fakultät

Department of Mathematics

Module Handbook

Mathematics
Bachelor of Education
im Höheren Lehramt an beruflichen Schulen*

Winter Semester 2026

Last updated on 20th August 2026

*This is a teaching degree for professional schools with a minor in mathematics. The modul handbook is valid for the 2026 study and examination regulations.

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1 Description of the Study Programme

1.1 Qualification Objectives

Within the teacher training Study Programme Bachelor of Education für das höhere Lehramt an beruflichen Schulen (B.Ed.) with the general education minor in Mathematics, graduates acquire basic and initial in-depth subject-specific and subject-didactic knowledge and skills necessary for a scientifically based teaching in higher education at professional schools.

Graduates are familiar with the fundamental questions in Linear Algebra, Analysis, Geometry, Algebra and Numerical Mathematics and master the central techniques for solving them. In doing so, they acquire basic mathematical thought patterns such as structuring problems, creating chains of argumentation and finally the proof of mathematical theorems. Graduates are able to communicate mathematical facts, use suitable media and establish links to school mathematics. They are able to justify the educational value of mathematical content and convey the societal significance of mathematics. With the Bachelor's degree, graduates are able to apply their knowledge and skills in a teaching-related Master's study programme or, with credit for the work completed, in a science-related Bachelor's degree programme in mathematics.

1.2 Structure of the Study Programme

In Mathematics, the first year of study is filled with the large compulsory module Foundations of Mathematics, which covers the subject-specific fundamentals of Analysis and Linear Algebra from an academic point of view. The corresponding lectures are accompanied by exercise classes, where students are intensively supervised and taught basic mathematical thinking and working methods as well as the ability to present solutions. In addition, the department provides students with revision sessions as question times.

In the second and third years of the programme, students deepen their theoretical knowledge. They expand their knowledge in the areas of Analysis, Algebra, Geometry and Numerical Mathematics. The content in the compulsory mathematics modules is taught through lectures and accompanying exercise classes. For each lecture there are weekly tasks, which students have to complete in paper form. In the exercise classes, the students present their solutions or create them under the supervision. Through this system, which is common in mathematical study programmes, students learn to systematically work on the tasks set for them and to practise analytical and structural thinking. Furthermore, they should be able to explain complex mathematical matters and present them verbally. This requires students to be able to organise themselves and to do a lot of self-study, which is provided for and credited in the course of study. At the same time, intensive supervision and individual support options are provided.

In addition to the subject modules, students in the third year of study take modules in the field of subject didactic. These build, wherever possible, on the competences acquired in the corresponding subject modules.

In the third year of study, students also complete a bachelor's thesis. This can be written in the professional subject or in the general education secondary subject (including their subject didactics).

Integrating a study component at a foreign university into teacher training studies is challenging, as it involves coordinating two subjects and Educational Sciences. Whether attempting to fulfil components in all areas during the stay at the other university or adjusting the study plan at the University of Tübingen to allocate parts of the curriculum to different semesters to create flexibility, ensuring not all three areas need to be covered at the foreign university presents a challenge. Complicating matters is the fact that in the field of Mathematics, all modules are mandatory, leaving little room for content customisation. Therefore, it is essential to plan a suitable timeframe for a study component at a foreign university through a personal consultation with the Faculty Course Advisor. Essentially, from the Mathematics perspective, any academic semester is suitable for this purpose. The decision will depend on the student's previous achievements and the courses offered at the chosen foreign university.

1.3 Examination Regulations

Oral examinations are conducted in the presence of at least two examiners or one examiner, along with an observer (see also Exam Regulations General Part §12 (2).

2 Study Plans

2.1 Overview by Modules

Here we provide an overview of the study plan as a table showing the modules to be taken.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: Foundations of Mathematics							
1+2	MAT-10-10	Foundations of Mathematics		PM		or.	27
		- Foundations of Mathematics 1	L+E+T		EC		
		- Foundations of Mathematics 2	L+E+T		EC		
		- Exploring Mathematics	P		PC		
Section 2: Compulsory Intermediate Modules							
3	MAT-20-01	Measure and Integration Theory	L+E	PM	EC	or.	4.5
3-6	MAT-20-06	Compulsory Intermediate Modules Algebra and Geometry		PM		or.	13.5
		- Algebraic Structures	L+E		EC		
		- Introduction to Galois Theory	L+E		EC		
		- Introduction to Geometry	L+E		EC		
3	MAT-20-13	Numerical Mathematics		PM		wr. o. or.	6
		- Introduction to Numerical Mathematics	L+E		EC		
		- Mathematical Software	P		PC		
Section 3: Didactics of Mathematics							
5-6	MAT-80-01	Subject Didactics Mathematics 1	LIC	PM	s.M.	wr., or., P o. T	3
5-6	MAT-80-02	Subject Didactics Mathematics 2	SLIC+SLIC	PM	-	wr., or., E, Pr o. T	6
Section 4: Bachelor Thesis							
6	MAT-30-40	Bachelor Thesis	BT	PM	s.M.	BT	6
Section 5: Transferable Credits for the Master Degree							
-	MAT-20-02	Introduction to Complex Analysis and Ordinary Differential Equations		WM		or.	9
		- Introduction to Complex Analysis	L+E		EC		
		- Introduction to ODE	L+E		EC		
-	MAT-20-12	Stochastics	L+E	PM	EC	wr. o. or.	9
-	MAT-40-53	Seminar: Mathematical Specialisation	S	WM	s.M.	Pr	4

Abbreviations:

Type of Module	: PM=compulsory module, WPM=elective module
Examination Type	: BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Course Work	: EC=exercise certificate, PEC=practical exercise certificate
Other	: h=hours, o.=or, s.M.=see module description, ST=suggested term

Note at the request of the student representatives on the Study Commission: For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

2.2 Overview by the Course of Studies

Firstly, we provide an overview of the possible course of study in the form of a table both for entry in the winter semester and for entry in the summer semester. The second subject and the area of educational sciences are not broken down in detail.

Study plan – Modules

FS	CPiM	Subject Mathematics			Main Subject	ES
1	14	Foundations of Mathematics (27 CP)			Social Pedagoy / Pedagogy (102 CP)	Education Science and Orientation Internship (12 CP)
2	13					
3	15	Compulsory Intermediate Modules Algebra and Geometry (13,5 CP)	Numerical Math. (6 CP)			
4	0					
5	7,5		Measure and Integration Theory (4,5 CP)	Subject Didactics Mathematics 2 (6 CP)		
6	10,5		SD Mathematics 1 (3 CP)			

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points), CPiM=credit points in mathematics, ES=educational science

Study plan – Submodules

FS	CP	List of Submodules	
1	14	Foundations of Mathematics 1 (13 CP)	
		Exploring Mathematics (1 CP)	
2	13	Foundations of Mathematics 2 (13 CP)	
3	9	Algebraic Structures (4,5 CP)	Introduction to die Numerical Mathematics (4,5 CP)
		Introduction to Geometry (4,5 CP)	Mathematical Software (1,5 CP)
4	0		
5	13,5		Measure and Integration Theory (4,5 CP)
			Subject Didactics Mathematics 2 - Part 1 (3 CP)
6	10,5	Introduction to Galois Theory (4,5 CP)	Subject Didactics Mathematics 2 - Part 2 (3 CP)
		possibly Bachelor Thesis (6 CP)	Subject Didactics Mathematics 1 (3 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Alternative study plan – Submodules

FS	CP	List of Submodules	
1	14	Foundations of Mathematics 1 (13 CP)	
		Exploring Mathematics (1 CP)	
2	13	Foundations of Mathematics 2 (13 CP)	
3	15	Introduction to die Numerical Mathematics (4,5 CP)	Subject Didactics Mathematics 2 - Part 1 (3 CP)
		Mathematical Software (1,5 CP)	
4	0		
5	7,5	Algebraic Structures (4,5 CP)	Measure and Integration Theory (4,5 CP)
		Introduction to Geometry (4,5 CP)	
6	10,5	Introduction to Galois Theory (4,5 CP)	Subject Didactics Mathematics 2 - Part 2 (3 CP)
		possibly Bachelor Thesis (6 CP)	Subject Didactics Mathematics 1 (3 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

2.3 Overview of Programme Structure with Semester Assignment

Overview of Programme Structure with Semester Assignment for Students Starting in the Winter Semester																	
		Exam				Teaching				Semester							
		Type of Exam	Duration (min)	Grading	Weight in the final grade	Type of Course	Status	SWS	ECTS Points (CP)	The allocation of examinations / ECTS points to semesters is of a recommendatory nature. The allocation of ECTS points to courses are of an informative nature. Credits are only awarded upon completion of the module.							
										1. CP	2. CP	3. CP	4. CP	5. CP	6. CP		
Section 1: Foundations of Mathematics									**27**								
Foundations of Mathematics								26	27								
1.	Lecture	or.	30-40	g	27	L	o	12		9	9						
2.	Exercise class					E	o	6		4	4						
3.	Revision course					R	o	6		0	0						
4.	Praktical course					P	o	2		1							
Section 2: Compulsory Intermediate Modules									**24**								
Compulsory Intermediate Modules Algebra and Geometry								9	13,5								
1.	Lecture	or.	20-30	g	13,5	L	o	6				6	3				
2.	Exercise class					E	o	3				3	1,5				
Measure and Integration Theory								9	4,5								
1.	Lecture	or.	20-30	g	4,5	L	o	6						3			
2.	Exercise class					E	o	3						1,5			
Numerical Mathematics								5	6								
1.	Lecture	wr. o. or.	90-180 o. 20-30	g	6	L	o	2				3					
2.	Exercise class					E	o	1				1,5					
3.	Praktical course	-		ng		P	o	1				1,5					
Section 3: Subject Didactics Mathematics									**9**								
Subject Didactics Mathematics 1								2	3								
1.	Subject Didactics Mathematics 1	wr., or., P o. T	90-180 o. 20-30	g	3	LIC	o	2							3		
Subject Didactics Mathematics 2								4	6								
1.	Subject Didactics Mathematics 2 – Part 1	wr., or., Pr, E, P o. T	90-180 o. 20-30	g	3	SLIC	o	2						3			

Overview of Programme Structure with Semester Assignment for Students Starting in the Winter Semester																	
		Exam				Teaching				Semester							
		Type of Exam	Duration (min)	Grading	Weight in the final grade	Type of Course	Status	SWS	ECTS Points (CP)	The allocation of examinations / ECTS points to semesters is of a recommendatory nature. The allocation of ECTS points to courses are of an informative nature. Credits are only awarded upon completion of the module.							
										1. CP	2. CP	3. CP	4. CP	5. CP	6. CP		
2.	Subject Didactics Mathematics 2 – Part 2	wr., or., Pr, E, P o. T	90-180 o. 20-30	g	3	SL IC	o	2							3		
Section 4: Bachelor Thesis									**6**								
Bachelor Thesis									6								
1.	Bachelor thesis	BA		g		BA	o								6		

Explanation of the abbreviations:

Marking system : g=graded, ng=non graded
Form of examination : BA=bachelor thesis, Or.=oral exam, Wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continuous assessment tests
Form of teaching : L=lecture, SL=seminar or lecture, E= exercise class, R=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : o.=or, SWS=hours in class per week, CP=credit points=ECTS points

3 Module Descriptions

Section 1: Foundations of Mathematics

Module Number: **MAT-10-10**	**Module Title:** Foundations of Mathematics		**Type of Module:** Compulsory Module
ECTS-Points	27		
Workload **- Time in Class** **- Self-Study**	Workload: 810 h	Time in Class: 300 h	Self-Study: 510 h
Duration	2 Semester		
Frequency	every Semester		
Term	1+2		
Language of Instruction	German		
Forms of Teaching and Learning	1. Semester: Foundations of Mathematics 1, Lecture 6 SWS + Ex.cl. 3 SWS + Rev.c. 2 SWS 2. Semester: Foundations of Mathematics 2, Lecture 6 SWS + Ex.cl. 3 SWS + Rev.c. 2 SWS 1. Semester: Exploring Mathematics, Practical course 2 SWS		
Higher Objectives	In the Foundations of Mathematics module, students learn the essential conceptual and methodological foundations of linear algebra as well as single-variable and multivariable calculus, exploring their interconnections with particular emphasis on the similarities and differences in their approaches. In the oral exam, students demonstrate that they have recognised these relationships and are capable of contextualising the core results of the lectures within these frameworks. The duration of the module supports these objectives while also accounting for the acquisition of a new language - the language of mathematics - and the development of a precise and rigorously logical working methodology. This provides students with the necessary time to make the significant transition from school-level mathematics to university-level mathematics. By demonstrating a deeper and more integrated understanding in the oral exams, students establish a strong foundation for successful participation in all subsequent modules in their academic programme.		

Content	• Basic logic and sets. • Structure of real and complex numbers. • Sequences, convergence and series; criteria for convergence; power series, sequences of functions; pointwise and uniform covergence. • Continous functions in one dimension and between metric spaces and their properties. • One- and multidimensional differential calculus (especially: intermediate value theorem, Taylor expansion, implicit function theorem, inverse function theorem, extrema under constraints). • Onedimensional Riemann integral. • Basic concepts of topology in metric and normed spaces. • Vector spaces and linear maps. • Matrices and systems of linear equations. • Determinants, eigenvalues and diagonalisability. • Jordan canonical form. • Euclidean and unitary vector spaces, spectral theorems. • Basics of analytical geometry. • The lecture Foundations of Mathematics 1 focuses primarily on topics in one-dimensional analysis and introduces basic concepts of linear algebra up to systems of linear equations. The lecture Foundations of Mathematics 2 covers further aspects of linear algebra as well as multivariable analysis. • The submodule Exploring Mathematics serves as an introduction to mathematical working methods, mathematical modelling, and abstraction.
Objectives	The students are familiar with and understand the fundamental concepts, statements, and methods of single-variable and multivariable calculus as well as linear algebra. Their capacity for abstraction has been enhanced, they have been trained in analytical thinking, and their mathematical imagination has been stimulated. Through a proof- and structure-oriented approach, they have learned to comprehend mathematical proofs in calculus and linear algebra and to independently prove or disprove mathematical statements in simple examples. They have recognised the essential relationships within the theory of single-variable and multivariable calculus, their similarities and differences, as well as their connections to linear algebra, and are able to contextualise the core results of the lectures within these frameworks. Students are in principle able to derive a mathematical problem and approaches to its solution from a question that may not be formulated in mathematical terms by means of mathematical modelling, and to relate these back to the original question. In the exercises, they have developed a confident, precise, and independent approach to the concepts, statements, and methods covered in the lectures. Additionally, their presentation and communication skills have been cultivated through written assignments and presenting their own solutions. The students are capable of acquiring knowledge through self-study, while their teamwork abilities have been fostered through collaboration in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Foundations of Mathematics 1	L	o	6	9	yes	or.	30-40	g	100
	E	o	3	4					
	T	o	2	0					
Foundations of Mathematics 2	L	o	6	9	yes				
	E	o	3	4					
	T	o	2	0					
Exploring Mathematics	P	o	2	1	yes				

In each of the two submodules Foundations of Mathematics 1 and 2, an exercise certificate is required as course work. The exercise certificate is awarded on the basis of regular participation in the exercises together with successful completion of a test related to the exercises. Both components must be completed within the same semester. In the submodule Exploring Mathematics, a practical certificate is required as course work and is obtained through regular active participation.
The assessment of the module takes the form of an oral examination covering the submodules Foundations of Mathematics 1 and 2. Admission to the oral examination requires at least one of the two exercise certificates in the submodules Foundations of Mathematics 1 or 2. The module is deemed completed only once both exercise certificates and the practical certificate have been obtained and the oral examination has been passed.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature

Possible References :

- Anton Deitmar: Analysis. Springer 2016.
- Otto Forster: Analysis 1. Springer Spektrum 2013.
- Otto Forster: Analysis 2. Vieweg+Teubner 2011.
- Theodor Bröcker: Lineare Algebra und analytische Geometrie. Birkhäuser 2013.
- Gerd Fischer: Lineare Algebra. Springer Spektrum 2014.
- Daniel Grieser: Mathematisches Problemlösen und Beweisen. Springer Spektrum 2017.

Transfer

The successful participation in the module Foundations of Mathematics is a prerequisite for the participation in the module Bachelor Thesis. The exercise certificates of the module are prerequisite for all modules of the Sections 2-4.

Prerequisites

There are no prerequisites.

Responsible Persons

Daniele Agostini, Anton Deitmar, Frank Loose, Hannah Markwig, Thomas Markwig, Stefan Teufel

Abbreviations:

Grading System : g=graded, ng=not graded
Examination Type : BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 2: Compulsory Intermediate Modules

<table>
<tr><td>Module Number:
MAT-20-01</td><td colspan="2">Module Title:
Measure and Integration Theory</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">4.5</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
135 h</td><td>Time in Class:
45 h</td><td>Self-Study:
90 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">3</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture 2 SWS + Ex.cl. 1 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Measures and integrals.
• Lebesgue integral, Fubini’s theorem, transformation formula.
• Convergence theorems.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students know the basic terms, constructions, results and proving methods of integration theory in several real variables and in general measure spaces. Furthermore they are able to calculate the surface contents and the volumes even of complex bodies as well as multidimensional integrals. They have learned to transfer abstract questions of the subject into concrete problems and know important applications, e.g. in probability theory. In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students were trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Measure and Integration Theory</td><td>L</td><td>o</td><td>2</td><td>3</td><td rowspan="2">yes</td><td rowspan="2">or.</td><td rowspan="2">20-30</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>1</td><td>1,5</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired.</td></tr>
<tr><td>Literature</td><td colspan="3">Possible References :
• Heinz Bauer: Wahrscheinlichkeitstheorie und Grundzüge der Maßtheorie. De Gruyter 1978.
• Anton Deitmar: Analysis. Springer Spektrum 2017.
• Jürgen Elstrodt: Maß- und Integrationstheorie. Springer 2011.
• Otto Forster: Analysis 3. Friedr. Vieweg+Teubner 2011.</td></tr>
</table>

Transfer	If applicable, the module is prerequisite for the module Bachelor Thesis.
Prerequisites	At least one of the exercise certificates from the module Foundations of Mathematics must have been acquired.
Responsible Persons	Anton Deitmar, Peter Pickl, Reiner Schätzle, Stefan Teufel

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-20-06</td><td colspan="2">Module Title:
Compulsory Intermediate Modules Algebra and Geometry</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">13.5</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
405 h</td><td>Time in Class:
135 h</td><td>Self-Study:
270 h</td></tr>
<tr><td>Duration</td><td colspan="3">2 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">• Algebraic Structures, regularly every Semester
• Introduction to Galois Theory, regularly in Summer Semester
• Introduction to Geometry, regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">3-6</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">• Algebraic Structures, Lecture 2 SWS + Ex.cl. 1 SWS
• Introduction to Galois Theory, Lecture 2 SWS + Ex.cl. 1 SWS
• Introduction to Geometry, Lecture 2 SWS + Ex.cl. 1 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Algebraic Structures
– Groups, subgroups, group homomorphisms, normal subgroups, quotient group.
– Cyclic groups and the symmetric group.
– Commutative rings with one, divisibility.
– Euclidean rings, principal ideal domains, factorial rings.
– The ring of integers and the polynomial ring.
• Introduction to Galois Theory
– Fields and field extensions.
– Fundamental theorem of Galois theory and applications, in particular:
* Constructions with ruler and compass.
* Solvability of equations.
• Introduction to Geometry
– Selected topics in geometry from the following canon are covered:
* Axiomatic foundation of planar geometry.
* Euclidean geometry.
* Non-Euclidean geometry.
* Analytic geometry.
* Parametrised curves and surfaces.</td></tr>
</table>

Objectives

The students deepen their structural thinking, are familiar with fundamental algebraic concepts and can apply them to other mathematical disciplines. They understand, in particular through the example of field theory, how the interplay of different branches of algebra leads to new insights, including answers to classical questions from antiquity. In this context, they have experienced that the interaction of various areas of mathematics can be essential for solving concrete problems. They have become acquainted with a systematic approach to questions of geometry within a selected topic area and can apply methods from other areas of mathematics in geometry. They are familiar with the most fundamental statements and methods of these fields. Their capacity for abstraction has been enhanced, they have been trained in analytical thinking, and their mathematical imagination has been stimulated. Through a proof- and structure-oriented approach they have learnt to follow mathematical proofs in algebra and geometry and to prove or refute mathematical statements independently. They are able to place the structures studied in linear algebra in a broader context and to achieve a deeper understanding of them.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students was trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Algebraic Structures	L	o	2	3	yes	or.	20-30	g	100
	E	o	1	1,5					
Introduction to Galois Theory	L	o	2	3	yes				
	E	o	1	1,5					
Introduction to Geometry	L	o	2	3	yes				
	E	o	1	1,5					

In each of the three submodules, an exercise certificate is required as course work. The assessment of the module takes the form of an oral examination covering all submodules. Admission to the oral examination requires at least two of the three exercise certificates. The module is deemed completed only once all three exercise certificates have been obtained and the oral examination has been passed.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature	**Possible References :** • Serge Lang: Algebraische Strukturen. Vandenhoek & Ruprecht 1979. • Siegfried Bosch: Algebra. Springer 2009. • Gerd Fischer, Reinhard Sacher: Einführung in die Algebra. Teubner 1983. • Christian Karpfinger, Kurt Meyberg: Algebra: Gruppen-Ringe-Körper. Springer Spektrum 2010. • Hans-Jörg Reiffen, Günter Scheja, Udo Vetter: Algebra. Bibliographisches Institut 1984. • Michele Audin: Geometry. Springer 2003. • Marcel Berger: Geometry Revealed: A Jacob's Ladder to Modern Higher Geometry. Springer 2010. • David A. Brannan, Matthew F. Esplen, Jeremy J. Gray: Geometry. Cambridge University Press 2012. • John Stillwell: The four pillars of geometry. Springer 2005.
Transfer	-
Prerequisites	At least one of the exercise certificates from the module Foundations of Mathematics must have been acquired.
Responsible Persons	Daniele Agostini, Carla Cederbaum, Jürgen Hausen, Hannah Markwig, Thomas Markwig, Walther Paravicini

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-20-13</td><td colspan="2">Module Title:
Numerical Mathematics</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td>Time in Class:
60 h</td><td>Self-Study:
120 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">3</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">• Introduction to Numerical Mathematics, Lecture 2 SWS + Ex.cl. 1 SWS
• Mathematical Software, Practical course 1 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Interpolation and approximation of functions.
• Numeric integration and differentiation.
• Systems of linear equations and linear curve fitting.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students know the foundations of numerical mathematics and are capable of performing basic calculation techniques. They understand to bring the knowledge gathered in the modules Analysis and Linear Algbra in the analysis of numerical methods and to use the methods for specific problems. Their algorithmic thinking was enhanced and they are acquainted to the analysis of algorithms with a view to questions of efficiency and complexity.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students were trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Introduction to Numerical Mathematics</td><td>L</td><td>o</td><td>2</td><td>3</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">90-180 o. 20-30</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>1</td><td>1,5</td></tr>
<tr><td>Mathematical Software</td><td>P</td><td>o</td><td>1</td><td>1,5</td><td>yes</td><td>-</td><td>-</td><td>nb</td><td>0</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired. Whether the examination is written or oral is decided by the instructor with approval by the head of the examination board.</td></tr>
<tr><td>Literature</td><td colspan="3">Possible References :
• Peter Deuflhard, Andreas Hohmann: Numerische Mathematik 1. De Gruyter 2008.
• Martin Hanke-Bourgeois: Grundlagen der Numerischen Mathematik und des Wissenschaftlichen Rechnens. Vieweg+Teubner 2009.</td></tr>
<tr><td>Transfer</td><td colspan="3">If applicable, the module is prerequisite for the module Bachelor Thesis.</td></tr>
</table>

Prerequisites	At least one of the exercise certificates from the module Foundations in Mathematics must have been acquired. Furthermore, before admission to the examination, the practical certificate for the submodule Mathematical Software must have been obtained.
Responsible Persons	Christian Lubich, Andreas Prohl

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 3: Didactics of Mathematics

<table>
<tr><td>Module Number:
MAT-80-01</td><td colspan="2">Module Title:
Subject Didactics Mathematics 1</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">3</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
90 h</td><td>Time in Class:
30 h</td><td>Self-Study:
60 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Summer Semester</td></tr>
<tr><td>Term</td><td colspan="3">5-6</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise class, seminar, talk, presentation, e-learning, blended learning, project work, case studies</td></tr>
<tr><td>Content</td><td colspan="3">Didactics of Algebra and Arithmetic:
This course deals with the foundations of the didactics of mathematics in the educational plans and in particular the didactic reduction of important basic concepts of algebra and arithmetic to school level, various ways of introducing important concepts of algebra and arithmetic at school and ways of motivating basic algebraic and arithmetic ideas.</td></tr>
<tr><td>Objectives</td><td colspan="3">Students know the basic didactic principles of teaching concepts and can orientate themselves in the educational plans. They are able to compare and evaluate subject-specific approaches to central concepts in algebra and arithmetic. They have the ability to convey algebraic and arithmetic content in a way that is both student- and subject-orientated.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td>Subject Didactics Mathematics 1</td><td>LIC</td><td>o</td><td>2</td><td>3</td><td>no</td><td>wr., or., P o. T</td><td>90-180 o. 20-30</td><td>g</td><td>100</td></tr>
</table>
Whether the form of the examination is decided by the instructor with approval by the head of the examination board.
</td></tr>
<tr><td>Transfer</td><td colspan="3">The module Didactics of Mathematics 1 is compulsory for the module Bachelor Thesis, if the bachelor thesis is written in mathematics.</td></tr>
<tr><td>Prerequisites</td><td colspan="3">At least two of the exercise certificates from the module Foundations of Mathematics must have been acquired. One of these must be the exercise certificate for Linear Algebra 1.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Frank Loose, Walther Paravicini</td></tr>
<tr><td colspan="4">Abbreviations:
Grading System : g=graded, ng=not graded
Examination Type : BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week</td></tr>
</table>

<table>
<tr><td>Module Number:
MAT-80-02</td><td colspan="2">Module Title:
Subject Didactics Mathematics 2</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td>Time in Class:
60 h</td><td>Self-Study:
120 h</td></tr>
<tr><td>Duration</td><td colspan="3">2 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">every Semester</td></tr>
<tr><td>Term</td><td colspan="3">5-6</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise, proseminar, talk, presentation, e-learning, blended learning, project work, case studies</td></tr>
<tr><td>Content</td><td colspan="3">The module consists of the two parts
• didactics of geometry and linear algebra,
• didactics of analysis and stochastics.
It deals with the didactic reduction of important basic concepts of analysis, linear algebra, geometry or stochastics at school level, various options for introducing important terms in analysis, linear algebra, geometry or stochastics at school as well as motivational options for analytic, geometric and stochastic basic ideas.</td></tr>
<tr><td>Objectives</td><td colspan="3">Students are familiar with the basic didactic principles of teaching concepts. They are able to compare and evaluate subject-specific approaches to central concepts in analysis, linear algebra, geometry and stochastics. They have the ability to convey geometric and algebraic content in a way that is both student- and subject-orientated.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td>Subject Didactics Mathematics 2 – Part 1</td><td>SLIC</td><td>o</td><td>2</td><td>3</td><td>yes</td><td>wr., or., E, Pr o. T</td><td>90-180 o. 20-30</td><td>g</td><td>50</td></tr>
<tr><td>Subject Didactics Mathematics 2 – Part 2</td><td>SLIC</td><td>o</td><td>2</td><td>3</td><td>yes</td><td>wr., or., E, Pr o. T</td><td>90-180 o. 20-30</td><td>g</td><td>50</td></tr>
</table>
The module consists of two parts, for which the teaching learning methods (lecture, exercise class or seminar) as well as the type of examination (written or oral exam, presentation or paper, portfolio or tests) are usually different. This is taken into account by the fact that, the examination in this module consists of two equally weighted parts.</td></tr>
<tr><td>Transfer</td><td colspan="3">If applicable, part of the he module Subject Didactics of Mathematics 2 is a prerequisite for the module Bachelor Thesis, if the bachelor thesis is written in mathematics.</td></tr>
<tr><td>Prerequisites</td><td colspan="3">The module Foundations of Mathematics must be completed. The module Geometry should be taken parallel to the Didactics of Geometry or should have been taken beforehand, as knowledge from the module Geometry is required in the Didactics of Geometry module.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Frank Loose, Walther Paravicini</td></tr>
</table>

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 4: Bachelor Thesis

<table>
<tr><td>Module Number:
MAT-30-40</td><td colspan="2">Module Title:
Bachelor Thesis</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td>Time in Class:
regularly, as required</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">every Semester</td></tr>
<tr><td>Term</td><td colspan="3">6</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Bachelor thesis</td></tr>
<tr><td>Content</td><td colspan="3">The students have to work under instruction of an advisor on a defined task from mathematics or subject didactics mathematics with scientific methods and present the results in written form. In detail this includes:
the formulation of a scientific question in accordance with the advisor;
the independent search for and the study of relevant scientific literature;
the formulation of suited questions and methodical approaches for their solution;
the independent realisation of the project, the written presentation of the project and the reults in the context of the current state of research.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students
can work independently and with scientific methods on an assigned topic,
operate a literature research for scientific sources,
choose scientific methods and techniques or develop them further to solve a problem,
communicate the results in a clearly structured fashion and in academically suited form in their thesis.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3"><table><tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr><tr><td>Bachelor Thesis</td><td>BT</td><td>f</td><td>-</td><td>6</td><td>yes</td><td>BT</td><td>-</td><td>g</td><td>100</td></tr></table>The coursework consists of an examination interview on the contents of the bachelor thesis. The coursework is graded as pass or fail. The module grade is the grade for the bachelor thesis. The module is only passed if the examination and coursework have been successfully completed.</td></tr>
<tr><td>Transfer</td><td colspan="3">Bachelorarbeit</td></tr>
</table>

Prerequisites	Subject specific prerequisite for admission to the module Bachelor Thesis is besides the general part of the examination regulations the acquisition of the credit points from the modules of Section 1 Foundations of Mathematics as well as of at least 9 credit points from the modules of the Section 2 and at least 3 credit points from the modules of Section 3.
Responsible Persons	The dean of studies at the Department of Mathematics

Abbreviations:

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Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 5: Transferable Credits for the Master Degree

In anticipation of a prospective Master's programme in Master of Education for Secondary Schools at the University of Tübingen, certain credits may be earned during the Bachelor's programme that can be credited towards the Master's programme, provided specific conditions are met. This is intended to provide flexibility in individual study planning when transitioning from the Bachelor to the Master of Education.

Conditions and Scope

In the Bachelor of Education programme, up to 24 ECTS credits can be earned as pre-study credits for the Master's programme, if all the following conditions are met:

- There is an enrolment (matriculation) in and an examination entitlement in the Bachelor of Education im Höheren Lehramt an beruflichen Schulen;
- A total of at least 150 ECTS credits have already been acquired in the two main subjects and in educational sciences;
- There is an enrolment in and an examination entitlement in the subject in which credits for the Master's programme are to be acquired.

It can be freely chosen how many ECTS credits are earned in which of the studied subjects. For example, all 24 ECTS credits can be earned in one subject if modules are offered in the required extent. Master's modules of a subject taken as a third subject cannot be advanced. Module examinations within the framework of Master's credits can only be repeated once. For further regulations concerning Master's credits, please refer to the study and examination regulations.

Module Number: **MAT-20-02**	**Module Title:** Introduction to Complex Analysis and Ordinary Differential Equations		**Type of Module:** Elective Module
ECTS-Points	9		
Workload **- Time in Class** **- Self-Study**	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	2 Semester		
Frequency	• Introduction to Complex Analysis, regularly in Summer Semester • Introduction to ODE, regularly in Winter Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	• Introduction to Complex Analysis, Lecture 2 SWS + Ex.cl. 1 SWS • Introduction to ODE, Lecture 2 SWS + Ex.cl. 1 SWS		

Content

- Complex Analysis:
  - Holomorphic functions, Cauchy-Riemann equations.
  - Antiderivatives, Cauchy's integral formula, Cauchy's integral theorem.
  - Compact convergence of families of functions, power series, identity theorem.
  - Liouville's theorem, inverse function theorem for holomorphic functions, open mapping theorem, maximum principle.
  - Laurent series.
  - Residue theorem and applications.
- Ordinary differential equations, a choice of the following:
  - Picard-Lindelöf existence and uniqueness theorem.
  - Linear ordinary differential equations, Gronwall's lemma.
  - Continous and differential dependence on initial conditions.
  - Basics of dynamical systems, stability of equilibrium positions.
  - Ordinary differential equations over the complex numbers.

Objectives

The students know the foundations of the theory of complex analysis and ordinary differential equations. The are acquainted to essential calculation techniques and can calculate line integrals as well as explicitly solve simple differential equations. They know fundamental applications of the theory like e.g. the fundamental theorem of algebra and the Newtonian equations of motion. They also have the ability to transfer abstract questions into concrete problems of complex analysis or respectively of ordinary differential equations and solve them this way.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students was trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Introduction to Complex Analysis	L	o	2	3	yes	or.	20-30	g	100
	E	o	1	1,5					
Introduction to ODE	L	o	2	3	yes				
	E	o	1	1,5					

In each of the two submodules, an exercise certificate is required as course work. The assessment of the module takes the form of an oral examination covering all submodules. Admission to the oral examination requires both exercise certificates.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature	**Possible References :** • Lars Valerian Ahlfors: Complex analysis. McGraw-Hill 1979. • John B. Conway: Functions of one complex variable. Springer 1996. • Wolfgang Fischer, Ingo Lieb: Einführung in die Komplexe Analysis. Springer 2010. • Walter Rudin: Reelle und komplexe Analysis. Oldenbourg 2009. • Earl A. Coddington, Norman Levinson: Theory of ordinary differential equations. McGraw-Hill 1955. • William T. Reid: Ordinary differential equations. John Wiley & Sons 1971. • Hille, Einar: Ordinary differential equations in the complex domain. Dover Publications 1997. • Wasow, Wolfgang: Asymptotic expansions for ordinary differential equations. John Wiley 1965.
Transfer	It is to be transferred to the consecutive master's programme.
Prerequisites	Knowledge from the module Foundations of Mathematics (MAT-10-10) is required.
Responsible Persons	Anton Deitmar, Reiner Schätzle, Stefan Teufel

Abbreviations:

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Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-20-12</td><td colspan="2">Module Title:
Stochastics</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td>Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Summer Semester</td></tr>
<tr><td>Term</td><td colspan="3">-</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture 4 SWS + Ex.cl. 2 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Introduction to probability theory and statistics.
• Topics from probability theory: Probability spaces, simple conditional probabilities, urn models, random variables, distribution functions, discret and continous distributions, expectation and variance, inequalities, independence, joint probability distribution, notions of convergence, laws of lagre numbers, central limit theorem.
• Topics from statistics: Point estimators, hypothesis testing, standard testing methods.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students know the basic principles of stochastics. They have the ability to abstract stochastic questions and are capable of using their knowledge on specific problems.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students were trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3"><table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Stochastics</td><td>L</td><td>o</td><td>4</td><td>6</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">90-180 o. 20-30</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>2</td><td>3</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired. Whether the examination is written or oral is decided by the instructor with approval by the head of the examination board.</td></tr>
<tr><td>Literature</td><td colspan="3">Possible References :
• Hans-Otto Georgii: Stochastik. De Gruyter 2015.
• Ulrich Krengel: Einführung in die Wahrscheinlichkeitstheorie und Statistik. Vieweg 2005.</td></tr>
<tr><td>Transfer</td><td colspan="3">It is to be transferred to the consecutive master's programme.</td></tr>
<tr><td>Prerequisites</td><td colspan="3">The module Foundations of Mathematics must be completed. In addition, the other requirements for taking courses from the Master programme must be observed. Prior knowledge of the submodule Measure and Integration Theory is assumed.</td></tr>
</table>

Responsible Persons	Martin Möhle, Elmar Teufl

Abbreviations:

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Teaching Format	: L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-40-53	**Module Title:** Seminar: Mathematical Specialisation		**Type of Module:** Elective Module
ECTS-Points	4		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Seminar, talk, presentation, e-learning, blended learning		
Content	Various topics from the advanced fields of mathematics.		
Objectives	The students independently work on a coherent mathematical topic and prepare it in a didactical appealing fashion. They learn how to present their work to a group, how to be responsive to questions regarding the content and how to lead a professional discussion. The work and the presentation may be the foundation or a deepened study in the scope of a master thesis.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Seminar	S	o	2	4	yes	Pr	60-90	g	100

The acquisition of the credit points requires alongside with a successful presentation the regular active participation in the course, like by asking questions, contributing to a discussion or working on problem tasks. Additionally a written elaboration of the own talk or the issue of a handout for the participants may be required. These further efforts constitute the coursework of the module.

Transfer	It is to be transferred to the consecutive master's programme.
Prerequisites	The participation in the module requires the successful completion of at least one of the modules Introduction to Complex Analysis and Ordinary Differential Equations or Stochastics.
Responsible Persons	The dean of studies at the Department of Mathematics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : BT=bachelor's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week