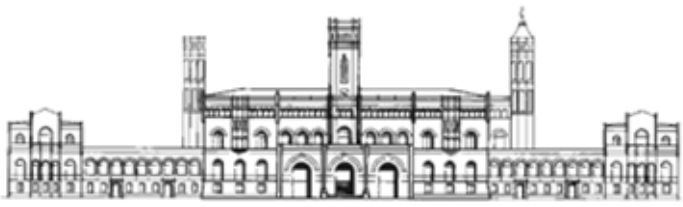
Leibniz Universität Hannover

Bachelor's degree programme Mathematics (DE)
Master's degree programme Mathematics (EN + DE)

module handbook

Status 12.07.2023

Faculty of Mathematics and Physics
of the Leibniz University Hannover (LUH)



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Preface

This document consists of three parts:

- In the first part, central contact persons are introduced and an introduction to the study program is given.
- The second part is the module handbook, it presents the modules and the courses.
- The third part contains further important information about the study program. Above all, the other institutions important for the study are listed.

The module handbook mathematics as the second part, in turn, consists of two parts, the module descriptions and the course catalog. Since different lectures can be chosen in the compulsory elective modules, these are described in more detail in the appendix. Thus, in such cases, the information on the content and frequency of offering can be found with the lectures and not with the modules.

Please note that this is a compilation of lectures in mathematics that are offered on a regular basis. In particular, other lectures in the course catalog (online) may be assigned to the compulsory elective modules.

The module handbook should also be understood as a supplement to the examination regulations. The current version of our examination regulations can be found at
Bachelor's degree programme:
https://www.uni-hannover.de/de/studium/im-studium/pruefungsinfos-fachberatung/mathematik-bsc/ordnungen/
Master's degree programme:
https://www.uni-hannover.de/de/studium/im-studium/pruefungsinfos-fachberatung/mathematik-msc/ordnungen/

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The faculty at a glance

The faculty

www.maphy.uni-hannover.de

The phone numbers are 0511 - 762 - ****, where **** stands for the numbers listed below.

The dean heads the faculty. The Dean of Studies is responsible for the teaching program. He is substituted by the Vice-Dean of Studies.

Dean

Prof. Dr. Alexander Heisterkamp

Dean of studies

Prof. Dr. Wolfram Bauer — *studiendekan@maphy.uni-hannover.de* -4466

Vice-Dean of Studies

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Dean of studies office

Mariana Stateva-Andonova — *studiensekretariat@maphy.uni-hannover.de* - 4466

Appelstraße 11A (Raum A120)
30167 Hannover

The mathematical institutes of the faculty*www.maphy.uni-hannover.de/de/institute*

The Faculty of Mathematics and Physics consists of thirteen institutes. The area of mathematics includes six institutes in addition to the Institute for Didactics of Mathematics and Physics.

The mathematical institutes are located in the main building of the university (Welfengarten 1, 30167 Hannover).

Institute of Algebra, Number Theory and Discrete Mathematics (Institute of Algebra, Number Theory and Discrete Mathematics)
www.iazd.uni-hannover.de

Institute of Algebraic Geometry (Institute of Algebraische Geometrie)
www.iag.uni-hannover.de

Institute of Analysis (Institute of Analysis)
www.analysis.uni-hannover.de

Institute of Applied Mathematics (Institute of Angewandte Mathematik)
www.ifam.uni-hannover.de

Institute of Mathematics and Physics Education (Institute of Didaktik der Mathematik und Physik)
www.idmp.uni-hannover.de

Institute of Differential Geometry (Institute of Differentialgeometrie)
www.diffgeo.uni-hannover.de

Institute of Actuarial and Financial mathematics (Institut für Versicherungs- und Finanzmathematik)
www.ivfm.uni-hannover.de

The comwithtees of the faculty

The current members of the following comwithtees can be found on the homepage of the Faculty of Mathematics and Physics (www.maphy.uni-hannover.de). The e-mail addresses of the student representatives can be found on the homepage of the Faculty of Mathematics and Physics.

Faculty Council

The Faculty Council decides on matters of research and teaching of fundamental importance. It decides on the regulations of the faculty, in particular the study and examination regulations. The Faculty Council consists of seven professors, two research assistants, two students, two representatives of the doctoral candidates (without voting rights) and two employees of the Technical and Administrative Services (MTV group); the Dean chairs the meetings. Most of the meetings are open to the public and take place on Wednesdays during the lecture period, approximately once a month.

Comwithee on teaching and the curriculum

The Comwithtee on teaching and the curriculumshall be consulted before decisions are made by the Faculty Council in all matters concerning teaching, studies and examinations. The Faculty Council has to evaluate the recommendations. The Study Commission consists of two professors, one member of the research staff and four students as voting members; the Dean of Studies is the chairperson. The Study Commission usually meets two weeks before the Faculty Council.

Examination Board

The Mathematics Examination Board ensures that the examinations for the Bachelor's and Master's degree programs in mathematics are conducted. It ensures that the examination regulations are observed. The examination board also decides in cases of doubt in examination matters.

A concern for the examination board is usually addressed directly to the chairman of the examination board.

The Student Body Council

The students of the Faculty of Mathematics and Physics form the joint Mathematics/Physics Student Body Council. The interests of the student body are represented by the open student body council, in which all students can participate. The student council meets every Monday at 6:15 p.m. during the lecture period in the student body room.

The main task of the student body council is to represent the students' interests in the comwithtees of the faculty. Through the student representatives, the student body council is involved, for example, in the design of study and examination regulations or the use of tuition fees, and can participate in the decision-making process for new professors in the appointment comwithtees. It also participates in interdisciplinary comwithtees.

If you are interested in actively participating in the planning of teaching and research - i.e. in the comwithtees - you are always welcome to join the Student body Council.

What else the student body council does can be found in chapter 4.1.6.
Contact:

Fachschaft Mathematik und Physik	info@fsr-maphy.uni-hannover.de
Welfengarten 1 (Raum d 414)	Tel.: 0511-762-7405
30167 Hannover	*www.fsr-maphy.uni-hannover.de*

The study of mathematics at Leibniz University Hannover

The degree programmes

At Leibniz University Hannover, you can study mathematics within the framework of several Bachelor's (BA) and Master's (MA) degree programmes. The Bachelor's and Master's degree programme's in mathematics is a specialized course of study with the goal of working in mathematical research or in companies in the economy. In addition, we offer degree programme's that serve to train teachers in mathematics. These will not be further discussed here in the following. In addition to the three major areas of "Pure Mathematics", "Applied Mathematics" and "Stochastics/Acturial and Financial Mathematics", a wide range of diverse coursesare offered through

a broad spectrum of research areas - from the basics to advanced theories to widely spread application areas. This diversity is reflected in an extensive range of courses, which can be used to develop one's own profile, especially in the in-depth modules in higher bachelor semesters and in the master phase.

What are the goals of each degree programme?

Career objective Activity in research or business

The **bachelor's degree programme** serve primarily to provide science-oriented basic education. They provide a basis of basic mathematical knowledge. On this basis, the bachelor's degree programme in mathematics provides an overview of the entire spectrum of mathematics.
The main goal of the consecutive **master's degree programme** in mathematics is to enable students to work efficiently and independently at the cutting edge of research and in innovative fields in technology and business, as well as in all responsible positions in government and society. This requires both a deepening of the subject matter and the introduction to the practice of independent work in science. The Master's degree programme at Leibniz University thus also offers the opportunity to deepen one's knowledge in the areas of one's inclination.

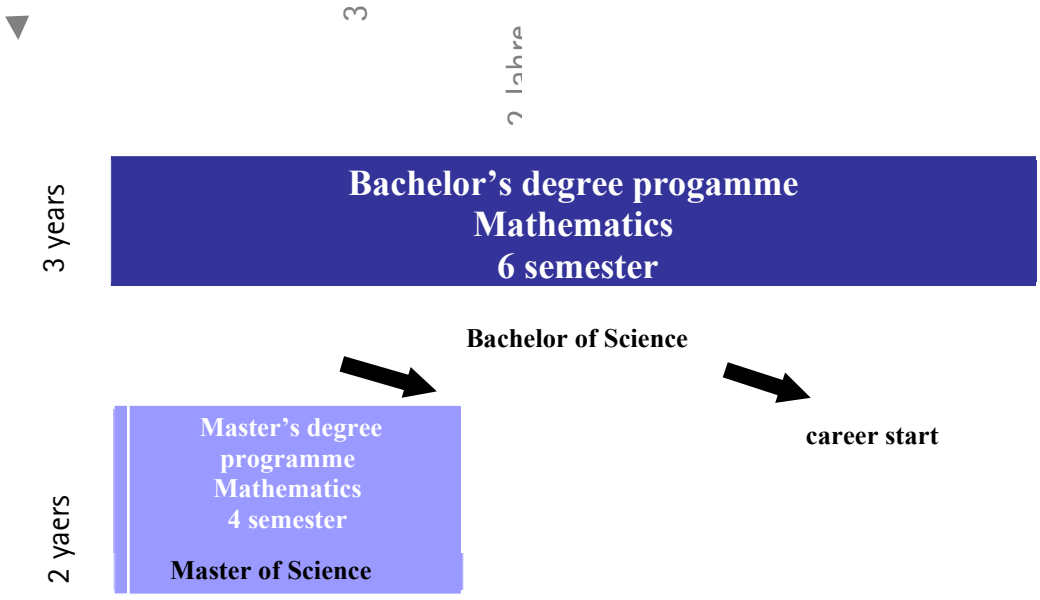
What are the career opportunities after graduation?

The Bachelor's degree programme serve to enable the transition to a subsequent master's degree programme or a qualified change to other disciplines. They can also **be professionally qualifying** in their own right for certain fields of activity.

Conceivable occupational fields will be found where companies offer career starters a further qualification based on sound mathematical basic knowledge according to the company's needs (e.g. in special trainee programs). On the other hand, companies may have a need for graduates of the bachelor's program in mathematics for tasks that require analytical skills and the ability to abstract, but for which the comprehensive scientific qualification acquired in the master's program is not completely necessary. In marketing and sales or project management, for example, this would be conceivable.
The **consecutive Master's degree programme** is research-oriented. A successful master's degree is also the prerequisite for being able to obtain a doctorate as part of a subsequent professional and research activity.

Because of these diverse foundational skills, mathematicians can work in publicly funded or industrial research laboratories. Common fields of employment also include banking and insurance. But mathematicians are also sought-after employees outside their immediate field, such as in information technology and management consulting. They are often active in areas for which they were not directly trained during their studies and can be found wherever complex problems have to be dealt with in a structured manner in a rapidly changing environment and flexible, creative problem solvers are required.

Structure of the study programs



Structure of the study programme

Admission Requirements:
All **bachelor's degree programmes** offered by our faculty are unrestricted-admission programmes. This means that only a university entrance qualification is required to take up a course of study. This is usually provided by the Abitur. In addition to the general university entrance qualification, there are other ways to be adwithted to a course of study - e.g. the examination for the acquisition of the subject-related university entrance qualification after prior vocational training. More information on admission to studies without a high school diploma can be found on the university's homepage:
www.uni-hannover.de/de/studium/vor-dem-studium/bewerbung-und-zulassung/voraussetzungen-zum-studium/hochschulzugangsberechtigung/
The **Master's programs** are subject to restricted-admission. The exact rules (including exemption rules) can be found in the corresponding eligibility and admission regulations:
www.uni-hannover.de/de/studium/vor-dem-studium/bewerbung-und-zulassung/voraussetzungen-zum-studium/zugangsordnungen/

The application deadline for admission to a Master's degree programme is July 15 for the winter semester (May 31 for non-EU citizens) and January 15 for the summer semester (November 30 for non-EU citizens).

Studies:
The study contents are divided into so-called **modules**. A module is a thematic summary of courses. It can therefore contain more than one course. In addition to lectures, which are usually accompanied by tutorials, seminars also contribute to the education. In order to successfully complete amodule., students must complete **coursework (Course work)** and **examinations (Examination)** in the individual modules.
As a rule, a minimum number of points from exercises is required for the course work. Assessments of coursework are not included in the final grade.

The contents of a module are usually examined during the course of study by means of an oral examination or a written examination.
Each module is assigned so-called credit points according to the expected workload. After completion of the required course work and examinations, students are credited with the credit points assigned to the module.
Credit points according to the European Credit Transfer and Accumulation System (ECTS) describe the effort required to acquire the competence imparted by a module. One credit point (LP) corresponds to an estimated workload of 30 hours. Approximately 30 credit points are to be acquired per semester. At least **180 credit points** must be earned in the **bachelor's degree programme** and **120** in **the master's degree programme**. The modules extend over one to two semesters. As a rule, they require a workload of between 150 and 300 hours from the students, corresponding to 5 to 10 LP. In particular, the modules on final theses and the modules of the research phase in the Master's program require a workload that exceeds this standard scope.
The **foverall mark** is calculated as the mean of the examination grades weighted by the credit points of the modules. ***You can find out which modules you have to take in your degree programme in the examination regulations for your degree programme.***

Registration and conduct of module examinations:
Registration for each examination must be made with the Examinations Office within a set registration period. If a student fails an examination, he or she has the option of resit twice. Exceptions to this are the Bachelor's and Master's theses. They may be repeated once with a different topic.
The registration and examination dates can be found on the website of the Examinations Office, but they are also part of the respective examination regulations:www.uni-hannover.de/pruefungsamt

Bachelor's degree programme

Preliminary remark on the study plans

In the following sections you will find, among other things, specific **study plans** for the mathematics degree programs at Leibniz Universität Hannover. Please note that these course of study plans are merely **suggestions** for structuring your studies. They are by no means prescribed in this way. However, when planning your personal schedule, please note that some of the basic lectures in particular build strongly on each other and should therefore be listened to in the order given. If you have any questions, please do not hesitate to contact the study program coordination and the subject advisors.

Please note, that the Bachelor's degree programme is only offered in german language. The Master's degree programme on the other hand is offered both in English and German language.

Bachelor of Science in mathematics

	1. Semester	2. Semester	3. Semester	4. Semester	5. Semester	6. Semester	LP
basic modules	Calculus I 10 LP, SL, PL	Calculus II 10 LP, SL, PL	Calculus III 10 LP, SL, PL	Stochastics I 10 LP, SL, PL	(Calculus III 10 LP, SL, PL)		
	Linear Algebra I 10 LP, SL, PL	Linear Algebra II 10 LP, SL, PL	Algebra I 10 LP, SL, PL				
		algorithmic programming 4 LP, PL	numerical mathematics I 10 LP, SL, PL				84
Key competences	Seminar 5 LP, SL						5
Proseminar			Introductory seminar 5 LP, PL				5
Compul sory-elective				lecture in the scope of 40 CP with the accompanying courseworks and examinations			40
Computer Science	Fundamental theoretical computer science 5 LP, SL, PL (or 3. Sem.)				Data structures and algorithms 5 LP, SL, PL (or 3. Sem.)		10
Minor subject	Minor subjects are: physics, Economics, philosophy, Mechanical Engineering, Computer Science, Geodesy and Geoinformatics, Electrical Engineering and Business administration. More subjects are possible uppon application.						18
Seminar					Seminar 5 LP, PL		5
bachelor's thesis						bachelor's thesis 13 LP	13
LP/ examinations	30/4	24/3	depends on the individual shedule				**180**

standard period of study: 6 Semester (180 LP)

Compulsory-elective modules:
In the second study section, elective modules with a total of 40 credit points are to be selected. Possible in-depth modules are divided into the following topics:

Pure mathematics: geometry, analysis, algebra/number theory, discrete mathematics
Applied mathematics: Stochastics and financial mathematics, numerics.
It should be noted that there are restrictions on your freedom of choice: You must take at least 10 LP each from the areas of Pure Mathematics as well as from Applied Mathematics. Furthermore, in one of these areas both a basic module and a specialization module of the elective area must be taken. For details, please consult the examination regulations again.

Bachelor thesis:
The bachelor thesis should show that you are able to work independently on a problem from the subject according to scientific methods within a given period of time. The processing period is thirteen weeks. The bachelor thesis usually includes a seminar, which you should take in the 5th semester. The topic of your Bachelor's thesis will usually emerge from this seminar. But this is not mandatory. Contact the lecturers of mathematics and ask for suitable topics. In addition, the faculty will hold an annual information session to provide information about possible topics.
Admission Requirements: To register for the Bachelor's thesis, you must have already earned 120 credit points.
All other formalities for the Bachelor thesis can be found in the examination regulations.

Minor Subject:
In the Minor subject, students get to know the tasks and working methods of other disciplines. The total scope is 18 credit points (LP). The study of the Minorsubject usually begins in the third semester. However, deviations are possible depending on personal study planning.
Standard subjects are, for example, business administration, electrical engineering, geodesy, computer science, mechanical engineering, philosophy, physics and economics.
Other minor subjects are possible upon application to the examination board.
Students who wish to choose an minor subject not listed here should draft a study plan with a representative of the subject concerned and then subwith this to the examination board together with the application for admission to an additional elective subject.

Master study progam's

Master of Science in Mathematics

Structure of the Master of Science in Mathematics program

The master's program consists of the six compulsory-elective modules in the subject area, the key competencies module, the minor subject and the master's thesis.
In the compulsory-elective modules, courses of pure and applied mathematics can be chosen according to inclination. It is recommended to choose one module and one seminar from the area in which the master thesis is written.
The elective options are extensive. Therefore, the semester details can deviate strongly from the suggested course plan.

Semester/ field	**1. Semester**	**2. Semester**	**3. Semester**	**4. Semester**	**LP**
Module Pure Mathematics 1	4V+2Ü				10
Module Pure Mathematics 2		4V+2Ü			10
Module Pure Mathematics 1	4V+2Ü				10
Module Pure Mathematics 2		4V+2Ü			10
Compulsory-Elective Module 1			4V+2Ü		10
Compulsory-Elective Module 2			4V+2Ü		10
Seminar			Seminar		5
Key Competences		Key competences/Seminar			5
Minor Subject	Application Subjects are: BWL, Electrical engineering, Geodesy, computer science, mechanical engineering, philosophy, physics, insurance science, VWL other subjects possible on request				20
Master Thesis				Master Thesis	30

4V+2Ü means that lectures amounting to 4 semester hours and corresponding exercises amounting to 2 semester hours are heard.

Modules in Bachelor Mathematics

Compulsory modules Bachelor

Calculus I (Analysis I)			**0201**
Frequency	Winter Semester, annually		
Responsible for Module	Elmar Schrohe, Institute of Analysis		
Type of Course (Semester Hours (SWS)))	Lecture „Calculus I" (4 SWS) Excercise class for „Calculus I" (2 SWS)		
Performance record for the acquisition of the Credit Points	Course Work: Excercise class Examination: Written Exam		
Grade composition	Grade of the exam		
Credit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210

Competence Goals:
Competence in the use of mathematical language. Basic understanding of the correct solution of mathematical-scientific problems in higher-dimensional spaces with the help of convergence considerations, differentiation and integration. Confident in the use of appropriate methods and mathematical proof techniques. As a result of the exercise classes, students are familiar with mathematically exact formulations and modes of reasoning in simple contexts and are able to present them.

Contents:

- Number ranges, systematic introduction in the real and complex numbers
- Sequences and series;
- Convergence and continuity;
- Differentiation for functions in one variable;
- Integration for functions in one variable;
- Sequences of functions, power series

Basic literature:

- H. Amann & J. Escher: *Analysis I*, Birkhäuser Verlag, 2002
- O. Forster: *Analysis 1*, Vieweg+Teubner 2008
- H. Amann & J. Escher: *Analysis II*, Birkhäuser Verlag, 1999
- O. Forster: *Analysis 2*, Vieweg+Teubner, 2006

Recommended prior knowledge:
School knowledge in Mathematics (gymnasiale Oberstufte)

Entry requirements or limit on number if participants: none

Usability:

- Bachelor's degree programme Mathematics

Calculus II (Analysis II)	0202
Frequency	Summer Semester, annually
Responsible for Module	Elmar Schrohe, Institute of Analysis
Type of Course (Semester Hours (SWS))	Lecture „Calculus II" (4 SWS) Exercise class „Calculus II" (2 SWS)
Performance record for the acquisition of the Credit Points	Course work: Excercise class Examination: Written Exam
Grade composition	Grade of exam

Credit Points (ECTS): 10 **Study time in course (h):** 90 **Time for self-study (h):** 210

Competence Goals:
Basic understanding of the correct solution of mathematical-scientific tasks with the help of multi-dimensional convergence considerations, differential and integral calculus. Confident use of the corresponding methods and mathematical proof techniques. Ability to work in a team by working on tasks in groups and discussing them in the exercise class.

Contents:

- Basic topological concepts such as metric and normed spaces, convergence, continuity, completeness, compactness;Differentiation of functions in multiple variables, total and partial differentiability, theorem on inverse functions and implicit functions, local extrema with and without constraints; vector fields and potentials; curve integrals.Ordinary differential equations, existence, uniqueness, elementary solution methods.

Basic literature:

- 🕮 H. Amann & J. Escher: *Analysis II*, Birkhäuser Verlag, 1999
- 🕮 O. Forster: *Analysis 2*, Vieweg+Teubner, 2006
- 🕮 J. Jost: *Postmorn Analysis*, Springer Verlag 2005
- 🕮 K. Königsberger: *Analysis 2*, Springer Verlag 2004

Recommended prior knowledge:

- „Linear Algebra I"
- "Calculus I"

entry requirements and limit on the number of participants: none

Calculus III (Analysis III)	0203

Frequency	winter semester, annually
Responsible for Module	Elmar Schrohe, Institute of Analysis
Type of Course (Semester Hours (SWS))	Lecture „Calculus III" (4 SWS) Excercise class „Calculus III" (2 SWS)
Performance record for the acquisition of the Credit Point	Coursework: Excercise class Examination: Written or oral exam
Grade composition	grade of exam

Credit Points (ECTS): 10 **Study time in course (h):** 90 **Time for self-study (h):** 210

Competence Goals:
Deepened understanding of analytical methods, especially in measure and integration theory as well as vector analysis. Ability to independently work out more difficult mathematical arguments on topics of the lecture and to present them in the exercise groups.

Contents:

- Elements of the Lebesque theory of measurement
- Multidimensional Lebesgue's integral with essential theorems (monotone and dominated convergence, Fubini's theorem, transformation theorem)- Vector analysis; integral theoremsmanifolds

Basic literature:

- 🕮 H. Amann & J. Escher: *Analysis III*
- 🕮 W. M. Boothby: *An introduction to differentiable manifolds and Riemannian geometry*, Academic Press
- 🕮 O. Forster: *Analysis 3*, Vieweg+Teubner, 2008
- 🕮 J. Jost: *Postmorn Analysis*, Springer Verlag 2005

Recommended prior knowledge:

- „Analysis I + II"

Entry requirements or limit on number if participants: none

Usability:

- Bachelor's degree programme Mathematics

Linear Algebra I (Lineare Algebra I)	0101
Frequency	winter semester, annually
Responsible for module	Stefan Schreieder, Institute of Algebraic Geometry
Type of Course (Semester Hours (SWS))	Lecture „Linear Algebra I" (4 SWS) Excercise Class „Linear algebra I" (2 SWS)
Performance record for the acquisition of the Credit Point	The course work ist to be delivered in the context of the excercise class for „Linear Algebra I" Examination: Written Exam „Linear algebra I"
Grade composition	Grade of exam

Credit Points (ECTS): 10 **Study time in course (h):** 90 **Time for self-study (h):** 210

Competence Goals:

Basic understanding of mathematical thinking and its application to various problems. Confident handling of systems of linear equations and the associated solution methods and sound knowledge of the underlying algebraic structures. Ability to present mathematical arguments in an appropriate manner and knowledge of the appropriate methods for doing so.

Contents:
Linear algebra I:

- Basic properties of vector spaces (basis and dimension);
- Linear maps and matrices;
- determinants;
- linear systems of equations with solution methods (Gauss algorithm);
- Eigenvalues und Eigenvector;
- Diagonalisation.

Basic literature:

- G. Fischer: *Lineare algebra*, Springer 2013

Recommended prior knowledge:

- School knowledge in mathematics (gymnasiale Oberstufe)

Entry requirements or limit on number if participants:

Usability:

- Bachelor's degree programme

Introductory Computer practical work for Mathematics Students (Einführendes Computerpraktikum für Mathematikstudierende)				
Frequency	Winter semester, irregular			
Responsible for module	Matthias Schütt, Institute of Algebraic Geometry			
Type of Course (Semester Hours (SWS))	**Introductory Computer practical work** (3 SWS)			
Performance record for the acquisition of the Credit Points	Course work at the choice of the lecturer			
Grade composition	Not graded			
Credit Points (ECTS): 5	**Study time in course (h):** 60		**Time for self-study (h):**	90

Competence Goals:
Basic handling of networked (Linux/Unix) computer systems; ability to use computer algebra systems sensibly and in a targeted manner as an aid in solving problems from analysis and linear algebra; in particular, selection of suitable tools, recognition and avoidance of sources of error, familiarisation with the limits of such systems, use of visualisation and programming of small procedures of one's own; basics of the representation of mathematical facts in the text typesetting system LaTeX.

Contents:

- Confident handling as a user of (Unix) computers in multiuser operation;
- Basic functioning and use of a computer algebra system including initial programming experience;
- Creating simple mathematical texts with formulae under LaTeX;
- Exemplary applications from linear algebra (e.g. systems of linear equations), from calculus (e.g. zeros, graphs of functions) and in connection with school mathematics (e.g. greatest common divisor);
- Outlooks in the form of small projects: e.g. solution sets of polynomial equations in 1, 2 and 3 variables in visualisation, Chinese remainder theorem.

Basic literature:

🕮 T. Theobald, S. Iliman: *Einführung in die Computerorientierte Mathematik*, Springer Spektrum 2015

Recommended prior knowledge:

- Linear algebra, calculus at Abiturniveau
- Experience in using a computer to the extent of school knowledge

Entry requirements or limit on number if participants: none

Usability:

- Bachelor's degree programme

Linear algebra II (Lineare Algebra II)		0102
Frequency	Summer semester, annually	
Responsible for module	Stefan Schreieder, Institute of Algebraic Geometry	
Type of Course (Semester Hours (SWS))	Lecture „Linear algebra II" (4 SWS) Excercise class for „Linear algebra II" (2 SWS)	
Performance record for the acquisition of the Credit Points	The course work ist to be delivered in the context of the excercise class for „Linear Algebra II" Examination: Written Exam „Linear algebra II"	
Grade composition	Grade of exam	
Credit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210

Competence Goals:
Extended mathematical methodological competence in relation to linear structures and deepened understanding of algebraic methods and their relationships to geometric questions. Competence in the presentation of mathematical argumentation. Competence in the application of mathematical theories.

Contents:

- Euclidean and unitary vector spaces;
- Orthonormalizingprocesses;
- Orthogonal and unitary endomorphisms;
- quadrics;
- Jordan normal form;
- multilinear algebra.

Basic literature:

- 🕮 G. Fischer: *Linear algebra*, Springer 2013

Recommended prior knowledge:

- „Linear algebra I"

Entry requirements or limit on number if participants:

Usability:

- Bachelor's degree programme

Algebra I	0103
Frequency	Winter semester, annually
Responsible for module	Michael Cuntz, Institute of Algebra, Number Theory and discrete mathematics
Type of Course (Semester Hours (SWS))	Lecture „Algebra I" (4 SWS) Excercise class for „Algebra I" (2 SWS)
Performance record for the acquisition of the Credit Points	The course work ist to be delivered in the context of the excercise class. Examination: Written or oral exam
Grade composition	Grade of exam
Credit Points (ECTS): 10	**Study time in course (h):** 90 **Time for self-study (h):** 210

Competence Goals:
Deepening the understanding of algebraic structures; insight into cross-references in mathematics through applications of algebraic methods in the field of elementary number theory and in the solution of classical geometric construction problems. Ability to independently work out more difficult mathematical arguments on topics of the lecture and to present them in the exercise class groups.

Contents:
- Arithmetics of integers;
- Groups (permutationgroups, symmetrygroups, groupoperations);
- Ring (Ideale, Polynomringe, Teilbarkeit, euklidische Ringe, Primfaktorzerlegung);
- Arithmetik modulo n (Kongruenzen, prime Restklassengruppen);
- Körper (algebraische Körpererweiterungen, Konstruktionen with Zirkel und Lineal, Kreisteilungskörper, endliche Körper).

Basic literature:
- 🕮 G. Fischer: *Lehrbuch der Algebra,* Springer 2013
- 🕮 E. Kunz: *Algebra, Vieweg & Teubner 2013*
- 🕮 J. Wolfart: *Einführung in die Number Theory und Algebra, Vieweg & Teubner 2011*

Recommended prior knowledge:
- „Linear algebra I + II"

Entry requirements or limit on number if participants:

Practical methods of mathematics(Praktische Verfahren der Mathematik)	0301

Frequency	Winter semester and Summer semester, annually
Responsible for module	Marc Steinbach, Institute of applied Mathematics
Type of Course (Semester Hours (SWS))	Lecture „Numerical Mathematics I" (4 SWS) (Numerische Mathematik I) Excercise class for „Numerical Mathematics I" (2 SWS) Lecture „Algorithmic Programming" (2SWS) (Algorithmisches Programmieren) Excercise class for „Algorithmic Programming" (1 SWS)
Performance record for the acquisition of the Credit Points	Course Work: Excercise class for „Numerische Mathematik I" Examination: Written exam for „Numerical Mathematics I" and practical Programming exam for „Algorithmic Programming"
Grade composition	Weigthed mean of exam for „Numerical Mathematics I" (Gewicht 10) and the practical Programming exam (Gewicht 4)
Credit Points (ECTS): 14	**Study time in course (h):** 210 **Time for self-study (h):** 210

Competence Goals:
Numerical mathematics I: Knowledge of numerical methods for the approximate solution of simple mathematical problems. Assess the suitability of different methods. Recognise the limits of applicability of numerical methods.

Algorithmic programming: Ability to use programming languages in the modelling and treatment of problems from different areas of mathematics and their fields of application.

Contents:
Numerical Mathematics I I: Interpolation of functions by polynomials and splines, quadrature formulae for numerical integration, direct methods for linear systems of equations: LU- and Cholesky decomposition, iterative methods for linear systems of equations: Jacobi, Gauss-Seidel, conjugate gradients, Newton methods for non-linear systems of equations, condition of mathematical problems and stability of numerical algorithms.
Algorithmic Programming:
Implement and test elementary numerical algorithms in a high-level programming language..

Basic literature:
- 🕮 A. Quarteroni, R. Sacco, F. Saleri: *Numerische Mathematik I und II*, Springer-Verlag.
- 🕮 Ch. Eck, H. Garcke, P. Knabner: *Mathematische Modellbildung*, Springer-Verlag.

Recommended prior knowledge:
- „Linear algebra I + II" und „Calculus I + II"

Entry requirements or limit on number if participants:

Stochastic Methods (Stochastische Methoden)	0401
Frequency	Summer semester, annually
Responsible for module	Marco Meyer, Institut of Analysis
Type of Course (Semester Hours (SWS))	Lecture „Mathematical Stochastics I" (4 SWS) Excercise class for „Mathematical Stochastics I" (2 SWS)
Performance record for the acquisition of the Credit Points	Course work: Excercise class Examination: Written exam
Grade composition	Grade of exam
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90 **Time for self-study (h):** 210

Competence Goals:
Knowledge of the basics of combinatorics, probability theory and statistical methods. Understanding of the models, mastery of elementary stochastic thinking and proof techniques. Ability to mathematically describe and analyse simple random-dependent problems and to solve simple tasks with presentation in the exercise class.

Contents:
The lecture Stochastics I offers an introduction to the basic concepts of probability theory and statistics.
The topics include:

- Basic combinatoric concepts
- Axiom system of classical probability theory
- Random Variables and their distributions
- Expected values and variance
- Convergence concept in stochastics
- Limit theorems for sums of independent random variables
- Basics of descriptive and evaluative statistics

Basic literature:

- Georgii, H.: *Stochastik*, de Gruyter
- Jacod, J. & Protter. P: *Probability Essentials*, Springer
- Krengel, U.: *Einführung in die Wahrscheinlichkeitstheorie und Statistik, Vieweg & Teubner, 2005*

Recommended prior knowledge:

- "Linear algebra I und II"
- "Calculus I und II"

Entry requirements or limit on number if participants:

Usability:

- Bachelor's degree programme
- Interdisciplinary Bachelor's Degree (First teaching subject)
- Master's degree programme for Teacher Training Course for Grammar Schools (Second teaching subject)

Introductory seminar (Proseminar)	0001

Frequency	Winter semester and Summer semester, annually
Responsible for module	Dean of Studies
Type of Course (Semester Hours (SWS))	Proseminar (2 SWS)
Performance record for the acquisition of the Credit Points	Seminar assignment including written drafting
Grade composition	Grade of seminar assignment

Credit PointsCredit Points (ECTS): 5 **Study time in course (h):** 30 **Time for self-study (h):** 120

Competence Goals:

Written presentation of a concrete mathematical topic, its environment and, if applicable, its historical background. Oral presentation of the results. Ability to discuss with other participants. Use of suitable media (blackboard, PC) in the preparation and presentation.

Contents:
Varies, depending on the topic of the proseminars.

Basic literature:
- 🕮 Varies, depending on the topic of the proseminars..

Recommended prior knowledge:
Calculus I and Linear algebra I

Entry requirements or limit on number if participants:

Usability:
- Bachelor's degree programme

Compulsory electice modules Bachelor

Basic module Bachelor Algebra, Number Theory, Discrete Mathematics (Grundlagenmodul Bachelor Algebra, Zahlentheorie, Diskrete Mathematik)			0104
Responsible for module	Michael Cuntz, Institute of Algebra, Number Theory and Discrete Mathematics		
Courses	Lecture with Excercise class (4+2): **Algebra II** or **Discrete Mathematics** (see appendix)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: Depending on the course chosen, advanced knowledge in an area of algebra or basic knowledge of discrete mathematics, understanding of relational and operational structures and their algebraic treatment. Knowledge of basic functions of combinatorics, their methods and applications. Confident command of mathematical thinking and reasoning. Students are able to solve concrete tasks using appropriate methods.			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

Basic Module Bachelor Calculus (Grundlagenmodul Bachelor Analysis)			0204
Responsible for module	Wolfram Bauer, Institute of Analysis		
Courses	Lecture with Excercise class (4+2): **Complex analysis** or **Manifolds** (see appendix)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: Advanced acquisition of analytical ways of thinking depending on the chosen course on the basis of topics of complex analysis and topology. Confident mastery of mathematical thinking and argumentation. Students are able to solve concrete problems using suitable methods.			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

Basic module Bachelor Geometry (Basic module Bachelor Geometry)			0501
Responsible for module	Matthias Schütt, Institute of Algebraic Geometry		
Courses	Lecture with Excercise class (4+2): **Algebra II** or **Manifolds** (see appendix)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Credit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: Understanding of geometric constructions, spacial structures and the interplay of algebraic, geometric, analytical and topological methods. Confident command of mathematical thinking and reasoning. Students are able to solve concrete tasks using appropriate methods.			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

Basic module Bachelor Numerics (Basic module Bachelor Numerik)			0302
Responsible for module	Sven Beuchler, Institute of Applied Mathematics		
Courses	Lecture with Excercise class (4+2): **Numerical Mathematics II** (see appendix)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: Knowledge of numerical methods for the approximate solution of more demanding mathematical problems. Assessment of the suitability of different methods depending on the situation and the limits of the applicability of numerical methods. Confident mastery of mathematical thinking and argumentation. Students are able to solve concrete problems using suitable methods.			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

Basic module Bachelor Stochastics (Basic module Bachelor Stochastik)			0402
Responsible for module	Marco Meyer, Institute of Analysis		
Courses	Lecture with Excercise class (4+2): **(Mathematical Stochastics II) Mathematische Stochastik II** (see appendix)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: Advanced basic knowledge of stochastics and its applications; confident command of mathematical thinking and reasoning. Students are able to solve concrete problems using suitable methods. **Contents:** Measure-theoretical basics of probability theory, convergence types of stochastics, limit theorems, martingales			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

<table>
<tr><td colspan="3">Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics
(Spezialisierungsmodul Bachelor Algebra, Zahlentheorie und Diskrete Mathematik)</td><td>0105</td></tr>
<tr><td colspan="2">Responsible for module</td><td colspan="2">Ulrich Derenthal, Institute of Algebra, Number Theory and Discrete Mathematics</td></tr>
<tr><td colspan="2">Courses</td><td colspan="2">One Lecture and Excercise class (4+2) assigned to this module regarding the appendix

Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.</td></tr>
<tr><td colspan="2">Performance record for the acquisition of the Credit Points</td><td colspan="2">Course work: at the choice of the lecturer
Examination: written or oral exam at the choice of the lecturer</td></tr>
<tr><td>Credit PointsCredit Points (ECTS): 10</td><td>Study time in course (h): 90</td><td colspan="2">Time for self-study (h): 210</td></tr>
<tr><td colspan="4">Competence Goals:
In-depth understanding of algebraic ways of thinking and methods, good content knowledge in sub-areas of algebra or number theory. In-depth knowledge of the theory of relational and operational structures and their applications, e.g. in the area of coding, applied algebra or algebraic combinatorics.
Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.</td></tr>
<tr><td colspan="4">Entry requirements or limit on number if participants:</td></tr>
<tr><td colspan="4">Usability:
Bachelor's degree programme</td></tr>
</table>

Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics B (Spezialisierungsmodul Bachelor Algebra, Zahlentheorie und Diskrete Mathematik B)			**0105**
Responsible for module	Ulrich Derenthal, Institute of Algebra, Number Theory and Discrete Mathematics		
Courses	Two Lectures and Excercise classes (2+1) each assigned to this module regarding the appendix Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: each lecture a written or oral exam at the choice of the lecturer. The grade from the module is the weighted average from the grades of both courses.		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: In-depth understanding of algebraic ways of thinking and methods, good content knowledge in sub-areas of algebra or number theory. In-depth knowledge of the theory of relational and operational structures and their applications, e.g. in the area of coding, applied algebra or algebraic combinatorics. Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.			
Entry requirements or limit on number if participants:			

Advanced module Bachelor Calculus (Advanced module Bachelor Analysis)				0205
Responsible for module	Wolfram Bauer, Institute of Analysis			
Courses	One Lecture and Excercise class (4+2) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam at the choice of the lecturer			
Credit PointsCredit Points (ECTS):	10	**Study time in course (h):**	90	**Time for self-study (h):** 210
Competence Goals: Deepened understanding of general analytical, topological and complex-calculus theoretic methods, knowledge of qualitative methods for the investigation and solution of ordinary and partial differential equations. Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Advanced module Bachelor Calculus B (Advanced module Bachelor Analysis B)				0205
Responsible for module	Wolfram Bauer, Institute of Analysis			
Courses	Two Lectures with Excercise classes (each 2+1) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: each lecture a written or oral exam at the choice of the lecturer. The grade from the module is the weighted average from the grades of both courses.			
Credit PointsCredit Points (ECTS):	10	**Study time in course (h):**	90	**Time for self-study (h):** 210
Competence Goals: Deepened understanding of general analytical, topological and complex-calculus theoretic methods, knowledge of qualitative methods for the investigation and solution of ordinary and partial differential equations. Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Advanced Module Bachelor Geometry (Advanced module Bachelor Geometry)				0502
Responsible for module	Knut Smoczyk, Institute of Differential Geometry			
Courses	One Lecture und Excercise class (4+2) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam at the choice of the lecturer			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: In-depth knowledge of the connections between geometric, analytical, algebraic and topological structures, connection of spacial perception with axiomatic conceptualisations. Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Advanced module Bachelor Geometry (Advanced module Bachelor Geometry B)				0502
Responsible for module	Knut Smoczyk, Institute of Differentialgeometrie			
Courses	Two Lectures with Excercise classes (each 2+1) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examinations: each lecture a written or oral exam at the choice of the lecturer. The grade from the module is the weighted average from the grades of both courses.			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: In-depth knowledge of the connections between geometric, analytical, algebraic and topological structures, connection of spacial perception with axiomatic conceptualisations. Students have understood the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply appropriate solution methods. They are able to justify the procedure and explain it in an understandable way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Advanced Module Bachelor Numerics (Advanced module Bachelor Numerik)			0303
Responsible for module	Sven Beuchler, Institute of Applied Mathematics		
Courses	One Lecture and Excercise class (4+2) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam at the choice of the lecturer		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: In-depth knowledge of numerical methods for the approximate solution of concrete mathematical problems. Students have comprehended the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply suitable solution methods. They are able to justify the procedure and explain it in an understandable way.			
Entry requirements or limit on number if participants:			
Usability: • Bachelor's degree programme			

<table>
<tr><th colspan="3">Advanced module Bachelor Numerics B (Advanced module Bachelor Numerik B)</th><th>0303</th></tr>
<tr><td>Responsible for module</td><td colspan="3">Sven Beuchler, Institute of Applied Mathematics</td></tr>
<tr><td>Courses</td><td colspan="3">Two Lectures with Excercise classes (each 2+1) assigned to this module regarding the appendix.
Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.</td></tr>
<tr><td>Performance record for the acquisition of the Credit Points</td><td colspan="3">Course work: at the choice of the lecturer
Examination: each lecture a written or oral exam at the choice of the lecturer.
The grade from the module is the weighted average from the grades of both courses.</td></tr>
<tr><td>Credit PointsCredit Points (ECTS): 10</td><td>Study time in course (h): 90</td><td colspan="2">Time for self-study (h): 210</td></tr>
<tr><td colspan="4">Competence Goals:
In-depth knowledge of numerical methods for the approximate solution of concrete mathematical problems. Students have comprehended the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to analyse problems in the field, identify and apply suitable solution methods. They are able to justify the procedure and explain it in an understandable way.</td></tr>
<tr><td colspan="4">Entry requirements or limit on number if participants:</td></tr>
<tr><td colspan="4">Usability:
• Bachelor's degree programme</td></tr>
</table>

Advanced module Bachelor Stochastics (Advanced module Bachelor Stochastik)				0403
Responsible for module	Stefan Weber, Institute of Actuarial and Financial Mathematics			
Courses	One Lecture and Excercise class (4+2) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam at the choice of the lecturer			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: In-depth Knowledge of stochastics and its applications. The students are familiar with the the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to able to analyse problems in the field, to identify and apply suitable and apply them. They are able to justify the procedure and to explain them in a comprehensible way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Advanced module Bachelor Stochastics B (Advanced module Bachelor Stochastik B)				0403
Responsible for module	Stefan Weber, Institute of Actuarial and Financial Mathematics			
Courses	Two Lectures with Excercise classes (je 2+1) assigned to this module regarding the appendix. Additional Courses from the Course Catalog, which are not necessarily included here, can be assigned to this module also.			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: each lecture a written or oral exam at the choice of the lecturer The grade from the module is the weighted average from the grades of both courses.			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: In-depth Knowledge of stochastics and its applications. The students are familiar with the the logical structure of the field, are able to derive the most important statements and know the prominent examples. Students are able to able to analyse problems in the field, to identify and apply suitable and apply them. They are able to justify the procedure and to explain them in a comprehensible way.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Seminar (Seminar)				0950
Frequency	Winter semester or Summer semester			
Responsible for module	Dean of Studies			
Type of Course (Semester Hours (SWS))	Seminar (2 SWS)			
Performance record for the acquisition of the Credit Points	Seminar assignment – usually a presentation with a written drafting			
Grade composition	Grade of Seminar assignment			
Credit PointsCredit Points (ECTS): 5	**Study time in course (h)** 30		**Time for self-study (h):** 120	
Competence Goals: Ability to familiarise oneself with a mathematical topic under guidance. Acquisition of knowledge from books and journals, some of which are in English. Ability to write scientifically. Presentation techniques and use of media. Ability to discuss a mathematical topic. Achieving the Competence Goals requires continuous participation.				
Contents: Introduction to scientific work and scientific writing • Narrowed scientific topic on mathematics after consultation with the supervisor, • use of specialised literature/databases; • mathematical writing; • presentation techniques and use of media; The seminar prepares students for the start of a Bachelor's thesis.				
Basic literature: Depends on the topic of the seminar.				
Recommended prior knowledge: Depends on the topic of the seminar.				
Entry requirements or limit on number if participants:				
Usability: • Bachelor's degree programme				

Bachelor's thesis (Bachelorarbeit)	0901
Frequency	Start possible troughout the year
Responsible for module	Dean of Studies
Type of Course (Semester Hours (SWS))	Project „Bachelor's thesis" (13 LP)
Performance record for the acquisition of the Credit Points	Examination: Bachelor's thesis
Grade composition	Grade of the bachelor's thesis
Credit PointsCredit Points (ECTS): 13	**Study time in course (h) Time for self-study (h):** 390

Competence Goals:

Ability to independently familiarise oneself with a research topic. Acquisition of knowledge from books and journals, some of which are in English. Ability to plan realistically, manage time and carry out a scientific project according to scientific methods under guidance. Ability to write scientifically. Ability to discuss one's own work and to self-reflect.

Contents:

Introduction to scientific work, independent project work under guidance, scientific writing

- Narrowed scientific topic on mathematics after consultation with the supervisor,
- Use of specialist literature/databases;
- Mathematical writing;
- Presentation techniques and use of media;
- Planning the Bachelor's Thesis.

Basic literature:

Recommended prior knowledge:

In-depth study of a mathematical topic within the framework of a seminar

Entry requirements or limit on number if participants: at least 120 CP

Usability:

- Bachelor's degree programme

Prüfungsverfahren:

The topic of the Bachelor thesis is determined by the examiner after consultation with the candidate. The issue of the topic is to be recorded and the candidate and the Dean of Studies are to be informed in writing. The examiner is appointed when the topic is issued. The candidate is supervised by the examiner during the preparation of the thesis.

Modules in the master's degree programme Mathematics

Pure Mathematics 1 (Reine Mathematik 1)			0004
Responsible for module	Matthias Schütt, Institute of Algebraic Geometry		
Type of Course (Semester Hours (SWS))	one Lecture in pure Mathematics with Excercise class (4V + 2Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Grade composition	Grade of exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of pure mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Pure Mathematics 2 (Reine Mathematik 2)			0005
Responsible for module	Matthias Schütt, Institute of Algebraic Geometry		
Type of Course (Semester Hours (SWS))	one Lecture in pure Mathematics with Excercise class (4V + 2Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Grade composition	Note der mündlichen Prüfung or der Klausur		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of pure mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Pure Mathematics 3 (Reine Mathematik 3)			0005
Responsible for module	Matthias Schütt, Institute of Algebraic Geometry		
Type of Course (Semester Hours (SWS))	two lectures in pure mathematics with Excercise class (je 2V + 1Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: each lecture written or oral exam at the choice of the lecturer		
Grade composition	The grade from the module is the weighted average from the grades of both courses.		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: Master's degree programme MathematicsThe students broaden their mathematical knowledge. They gain insights into a selected area of pure mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Applied Mathematics 1 (Angewandte Mathematik 1)			0056
Responsible for module	Christoph Walker, Institute of Applied Mathematics		
Type of Course (Semester Hours (SWS))	one Lecture in Applied Mathematics with Excercise class (4V + 2Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Grade composition	Grade of the exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of applied mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Applied Mathematics 2 (Angewandte Mathematik 2)			0057
Responsible for module	Christoph Walker, Institute of Applied Mathematics		
Type of Course (Semester Hours (SWS))	one Lecture in Applied Mathematics with Excercise class (4V + 2Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Grade composition	Grade of exam		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of applied mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Applied Mathematics 3 (Angewandte Mathematik 1)			0057
Responsible for module	Christoph Walker, Institute of Applied Mathematics		
Type of Course (Semester Hours (SWS))	two Lectures in Applied Mathematics with Excercise classes (each 2V + 1Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: each lecture a written or oral exam at the choice of the lecturer		
Grade composition	The grade from the module is the weighted average from the grades of both courses.		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):**	210
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of applied mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Elective Module 1 (Wahlmodul 1)				0058
Responsible for module	Dean of Studies			
Type of Course (Semester Hours (SWS))	one Lecture in pure or applied mathematics with Excercise class (4V + 2Ü)			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam			
Grade composition	Grade of exam			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of mathematics of pure or applied mathematics. They acquire the ability to competently work on problems in this subfield.				
Entry requirements or limit on number if participants:				
Usability: • Master's degree programme Mathematics				

Elective Module 2 (Wahlmodul 2)				0059
Responsible for module	Dean of Studies			
Type of Course (Semester Hours (SWS))	one Lecture in pure or applied mathematics with Excercise class (4V + 2Ü)			
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam			
Grade composition	Grade of exam			
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90		**Time for self-study (h):** 210	
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of mathematics of pure or applied mathematics. They acquire the ability to competently work on problems in this subfield.				
Entry requirements or limit on number if participants:				
Usability: • Master's degree programme Mathematics				

Elective module 3 (Wahlmodul 3)			0059
Responsible for module	Dean of Studies		
Type of Course (Semester Hours (SWS))	two lectures in pure or applied mathematics with exercise class (je 2V + 1Ü)		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: written or oral exam		
Grade composition	The grade from the module is the weighted average from the grades of both courses.		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 90	**Time for self-study (h):** 210	
Competence Goals: The students broaden their mathematical knowledge. They gain insights into a selected area of mathematics of pure or applied mathematics. They acquire the ability to competently work on problems in this subfield.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Seminar I (Seminar I)			0060
Semesterlage	Each semester		
Responsible for module	Dean of Studies		
Type of Course (Semester Hours (SWS))	Seminar I (2 SWS)		
Performance record for the acquisition of the Credit Points	Examination: course-accompanying examination (VbP)		
Grade composition	Grade oft he VbP		
Credit PointsCredit Points (ECTS): 5	**Study time in course (h):** 30	**Time for self-study (h):** 30	
Competence Goals: Students possess the ability to independently familiarise themselves with a field of knowledge. This includes, in particular, the independent research of specialised literature on a given topic and the acquisition of knowledge from specialised books and articles. The students are able to recognise correlations in content. They acquire knowledge of the English technical language in order to be able to study corresponding technical literature. The students are able to structure a complex topic of modern mathematics appropriately and present it in an understandable way. They are capable of scientific discourse and self-reflection. The achievement of the Competence Goals requires continuous participation.			
Contents: Depending on the event. Current topics in various mathematical fields.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Seminar II			0060
Semesterlage	Each semester		
Responsible for module	Dean of Studies		
Type of Course (Semester Hours (SWS))	Seminar II (2 SWS)		
Performance record for the acquisition of the Credit Points	Examination: course-accompanying examination (VbP)		
Grade composition	Grade oft he VbP		
Credit PointsCredit Points (ECTS): 5	**Study time in course (h):** 30	**Time for self-study (h):** 30	
Competence Goals: Students possess the ability to independently familiarise themselves with a field of knowledge. This includes, in particular, the independent research of specialised literature on a given topic and the acquisition of knowledge from specialised books and articles. The students are able to recognise correlations in content. They acquire knowledge of the English technical language in order to be able to study corresponding technical literature. The students are able to structure a complex topic of modern mathematics appropriately and present it in an understandable way. They are capable of scientific discourse and self-reflection. The achievement of the Competence Goals requires continuous participation.			
Contents: Depending on the event. Current topics in various mathematical fields.			
Entry requirements or limit on number if participants:			
Usability: • Master's degree programme Mathematics			

Key Competencies (Schlüsselkompetenzen)			0061
Semesterlage	Each semester		
Responsible for module	Dean of Studies		
Type of Course (Semester Hours (SWS))	Course for Key Competencies		
Performance record for the acquisition of the Credit Points	Course work: at the choice of the lecturer Examination: none		
Grade composition	ungraded		
Credit PointsCredit Points (ECTS): 10	**Study time in course (h):** 60	**Time for self-study (h):** 240	
Competence Goals: At the choice of a Key Copentencies course, corresponding competencies are acquired. Achieving the Competence Goals requires continuous participation.			
Contents: Depends on the chosen course.			

Entry requirements or limit on number if participants:
Usability: • Master's degree programme Mathematics

Master's Thesis (Masterarbeit)			0902
Semesterlage		Start possible troughout the year	
Responsible for module		Dean of Studies	
Type of Course (Semester Hours (SWS))		Project „Master's Thesis"	
Performance record for the acquisition of the Credit Points		Course work: Oral Presentation Examination: Master's Thesis	
Grade composition		Grade of the Master's Thesis (Average grade from the two reviewers)	
Credit PointsCredit Points (ECTS):	30	**Workload(h):**	900

Competence Goals:

The students are able to work independently on a research project. They are able to structure, prepare and carry out scientific projects under guidance. They gain an overview of the current literature and analyse and solve complex problems. The students can lead critical discussions about their own and others' research results and deal constructively with questions and criticism. They have the competence to present mathematical facts independently.

Contents:
Introduction to scientific work, independent project work under guidance, scientific writing.

- current scientific problem in mathematics after consultation with the supervisor;
- mathematical writting;
- current specialist literature/databases

Entry requirements or limit on number if participants: at least 75 LP, Completion of the module Key competencies

Usability:

- Master's degree programme Mathematics

Examination procedure:
The topic of the Master's thesis is determined by the first examiner after consultation with the candidate. The issue of the topic is to be recorded and the candidate and the Dean of Studies are to be informed in writing. When the topic is issued, the first examiner and the second examiner are appointed. During the preparation of the thesis, the candidate is supervised by the first examiner.

Appendix – the lectures:

Here the courses which can be chosen in the compulsory-elective Bachelor and in the master modules are described.

The Courses in **Appendix A** can be chosen in the basic and advanced Bachelor modules. The Courses in **Appendix B** can be chosen in the master modules and partly in the advanced Bachelor modules.

The letters **R** and **A** right upper corner from the course description determine the classification of the course as a course in pure (R) or in applied (A) mathematics.

The sign ******* at the semester hours and Credit Points means that the course, depending on the overall offer of the respective semester, is offered as lecture with 4+2 SWS/ 10 LP or with 2+1 SWS/ 5 LP or as a Seminar. You will find precise details in the course catalogue.

The abbrevations used in the following mean:
IAG „Institute of Algebraic Geometry" (Institut für Algebraische Geometrie);
IAZD „Institute of Algebra, Number Theory and Discrete Mathematics" (Institut für Algebra, Zahlentheorie und Diskrete Mathematik),
IDG „Institute of Differential Geometry" (Institut für Differentialgeometrie)
IfAM „Institute of Applied Mathematics"; (Institut für Angewandte Mathematik)
IfVuF „Institute of Actuarial and Financial Mathematics" (Institut für Versicherungs- und Finanzmathematik);
IfA „Institute of Analysis" (Institut für Analysis).

A. Lecture's for the Bachelor basic modules

Algebra II (Algebra II)			R
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD Management of IAG
Frequency: annually, Summer semester			
Content: • Theory of fields (structure of finitely generated field extensions, Galois theory, Solvability of equations) • Modules and algebras (noetherian rings, Hilbert's basis theorem, integral ring extensions, modules over PID's, Theorem of Artin-Wedderburn, Tensorproducts) **Basic literature:** 🕮 J.C. Jantzen, J. Schwermer: *Algebra*, Springer 2006 **Recommended prior knowledge:** Algebra I			
Module assignment: • Basic module Bachelor Algebra, Number Theory, Discrete Mathematics • Basic module Bachelor Geometry • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Advanced module Bachelor Geometry			

Discrete Mathematics (Diskrete Mathematik)			R
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: annually, Summer semester			
Content: Topics of the lecture include: • Enumeration methods and Combinatoric • Generating Functions • Graph Theory • Error correcting codes • Counting under symmetries **Basic literature:** 🕮 M. Aigner: *Discrete Mathematics* 🕮 F. Harary: *Graphentheorie* **Recommended prior knowledge:** Algebra I			
Module assignment: • Basic module Bachelor Algebra, Number Theory, Discrete Mathematics			

Manifolds (Mannigfaltigkeiten)			R
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG
Frequency: annually, Summer semester			

Content:

- Topological and differentiable manifolds
- Tangent and cotangent spaces/bundles
- Differential forms, vector fields and flows
- Lie derivative, Lie groups and Lie algebras
- Integration on Manifolds, the theorems of Frobenius Stokes
- Vector bundles and tensor fields
- Connections on vector bundles, parallel transport, covariant derivative and holonomy

Basic literature:

- 🕮 Boothby, William M., *An introduction to differentiable manifolds and Riemannian geometry,* Academic Press, Inc., Orlando, FL, 1986
- 🕮 Milnor: *Topology from the Differentiable Viewpoint*, Princeton University Press
- 🕮 Lee, John M., Introduction to smooth manifolds, Graduate Texts in Mathematics 218, Springer-Verlag, New York
- 🕮 Warner, Frank W., Foundations of differentiable manifolds and Lie groups, Graduate Texts in Mathematics 94, Springer-Verlag New York-Berlin

Recommended prior knowledge: Calculus III (Analysis III)

Module assignment:

- Basic module Bachelor Analysis
- Basic module Bachelor Geometry
- Advanced module Bachelor Analysis
- Advanced module Bachelor Geometry

Classical Differential Geometry (Klassische Differentialgeometrie)			R
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG
Frequency: annually, Winter semester			
Content: • regular submanifolds of arbitrary codimension • tangent spaces • First fundamental form, length of a rectifiable curve, induced volume measure on regular submanifolds • second Fundamental form, Gauss map, Weingarten map/shape operator, principal curvature, mean curvature, Gaussian curvature • Covariant derivatives on tangent and normal bundles • Inner geometry • Equations of Gauss (Theorema Egregium), Codazzi—Mainardi und Ricci • Global theory of curves and surfaces: isoperimetric inequality, Umlaufsatz, theorems of Fenchel and Gauss-Bonnet. **Basic literature:** • do Carmo, Manfredo P., *Differentialgeometrie von Kurven und Flächen,* Vieweg Studium: Aufbaukurs Mathematik, 1983 • Kühnel, Wolfgang: *Differentialgeometrie: Kurven - Flächen - Manifolds,* Aufbaukurs Mathematik, Springer Spektrum **Recommended prior knowledge:** Calculus I+II, Linear algebra I			
Module assignment: • Basic module Bachelor Analysis • Basic module Bachelor Geometry • Advanced module Bachelor Analysis • Advanced module Bachelor Geometry			

Complex analysis (Funktionentheorie)			R
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management Institute of Analysis
Frequency: annually, Summer semester			
Content: • Holomorphic and meromorphic functions • Cauchy's integral theorem • Local mapping properties of holomorphic functions • Residue theorem • Rieman mapping theorem **Basic literature:** 🕮 L. Ahlfors: *Complex Analysis*, McGraw-Hill, New York, 1978. 🕮 J. Conway: *Functions of one Complex Variable*, Springer-Verlag, New York 1995. 🕮 W. Rudin: *Real and Complex Analysis*, McGraw-Hill, New York, 1987. **Recommended prior knowledge:** Calculus I-III			
Module assignment: • Basic module Bachelor Analysis • Advanced module Bachelor Analysis			

Numerical Mathematics II (Numerische Mathematik II)			A
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IfAM
Frequency: annually, Summer semester			
Content: Numerical methods for eigenvalue problems: inverse Iteration, QR algorithm, Lanczos method. Initial value problems for ordinary differential equations: Runge-Kutta methods, adaptive stepsize control, stiff differential equations. **Basic literature:** 🕮 A. Quarteroni, R. Sacco, F. Saleri: *Numerische Mathematik I und II*, Springer-Verlag. **Recommended prior knowledge:** Numerical Mathematics I			
Module assignment: • Basic module Bachelor Numeric • Advanced module Bachelor Numeric			

Mathematische Stochastik II			A
Lecture type Bachelor	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Sebastian Riedel, Institute of Analysis
Frequency: annually, Winter semester			
Content: • Maßtheoretische Grundlagen • Klassische Grenzwertsätze • Martingale • Schätz- und Testtheorie **Basic literature:** 🕮 P. Billingsley: *Probability and Measure*, Wiley, New York, 1995. 🕮 L. Rüschendorf: *Mathematische Statistik*, Springer, Berlin, 2014. **Recommended prior knowledge:** Mathematische Stochastik I			
Module assignment: • Basic module Bachelor Stochastik • Advanced module Bachelor Stochastik			

B. Lectureen für Module im Master

B.1 Algebra, Number Theory and Discrete Mathematics:

Algebraische Number Theory I			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: alle zwei Jahre			
Content: Einführung in die algebraische Number Theory, ausführliche Behandlung der folgenden Themen: • Arithmetik algebraischer Zahlkörper • Zeta- und L-Reihen **Basic literature:** 🕮 Neukirch: *Algebraische Number Theory*, Springer Verlag 2006 **Recommended prior knowledge:** Algebra II			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Algebraische Number Theory II			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: alle zwei Jahre			
Content: Vertiefung der Algebraischen Number Theory durch die Behandlung eines or mehrere der folgenden Themenbereiche: • p-adische Zahlkörper • Klassenkörpertheorie • algorithmische Probleme **Basic literature:** 🕮 Neukirch: *Algebraische Number Theory*, Springer Verlag 2006 🕮 Cohen: *Topics in Computational Algebraic Number Theory*, Springer Verlag 2000 **Recommended prior knowledge:** Algebra II. Diese Lecture kann unabhängig von der Algebraischen Number Theory I besucht werden.			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Analytische Number Theory I			R
Lecture type Bachelor und Master	**SWS** 2+2	**Credit Points:** 5	**Responsibility** Management of IAZD
Frequency: unregelmäßig			
Content: Einführung in die analytische Number Theory, insbesondere Arithmetische Funktionen, Dirichletreihen, Perronsche Formel, analytische Eigenschaften der Zeta-Funktion, Primzahlsatz, Einführung in Siebmethoden **Basic literature:** 🕮 J. Brüdern, Einführung in die analytische Number Theory, Springer-Verlag, 1995. 🕮 H. Davenport, Multiplicative Number Theory, Springer-Verlag, 2000. 🕮 H.L. Montgomery and R.C. Vaughan, Multiplicative Number Theory, I. Classical Theory, Cambridge University Press, 2007. **Recommended prior knowledge:** Complex analysis			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik Jeweils kombinierbar with Lectureen der Algebra, Number Theory, Discrete Mathematics (insbesondere: Analytische Number Theory II) or Analysis or anderen Lectureen in Absprache with der/m Prüfenden.			

Analytische Number Theory II			R
Lecture type Bachelor und Master	**SWS** 2+2	**Credit Points:** 5	**Responsibility** Management of IAZD
Frequency: unregelmäßig			
Content: Vertiefung der analytischen Number Theory. Mögliche Themen umfassen den Satz von Bombieri-Vinogradov, Taubersche Sätze, Normalordnungen and Werteverteilung von additiven und multiplikativen Funktionen, Anwendungen der Selberg-Delange- und der Sattelpunktmethode. **Basic literature:** 🕮 J. Brüdern, Einführung in die analytische Number Theory, Springer-Verlag, 1995. 🕮 H. Davenport, Multiplicative Number Theory, Springer-Verlag, 2000. 🕮 H.L. Montgomery and R.C. Vaughan, Multiplicative Number Theory, I. Classical Theory, Cambridge University Press, 2007. 🕮 G. Tenenbaum, Introduction to analytic and probabilistic number theory, Cambridge University Press, 1995. **Recommended prior knowledge:** Complex analysis, Analytische Number Theory I **Bemerkung:** Jeweils kombinierbar with Lectureen der Algebra, Number Theory, Discrete Mathematics (insbesondere: Analytische Number Theory I) or Analysis or anderen Lectureen in Absprache with der/m Prüfenden			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Arithmetische Geometrie I			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: alle zwei Jahre, Winter semester			
Content: Einführende Lecture in die arithmetische Geometrie, anhand eines der folgenden Themen: • Diophantische Geometrie • Rationale und ganze Punkte auf algebraischen Varietäten • Elliptische Kurven **Basic literature:** 🕮 Lorenzini: *An Invitation to Arithmetic Geometry* 🕮 Silverman: *The Arithmetic of Elliptic Curves* 🕮 Poonen*: Rational Points on Varieties* **Recommended prior knowledge:** Algebra II			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Arithmetische Geometrie II			R
Lecture type Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: unregelmäßig			
Content: Vertiefende Lecture über einen der folgenden Themenbereiche: • Modulformen und Modularität • diophantische Geometrie • arithmetische Fundamentalgruppen **Basic literature:** 🕮 Diamond, Shurman: *A first course in modular forms* 🕮 Hindry, Silverman: *Diophantine Geometry* **Recommended prior knowledge:** Arithmetische Geometrie I or Algebraische Geometrie			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Homologische Algebra			R
Lecture type Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD
Frequency: unregelmäßig			
Content: Exakte Sequenzen; Homomorphismengruppen; Tensorprodukte von Moduln über Ringen; projektive, injektive und flache Moduln; Kategorien und Funktoren; (Ko-)Kettenkomplexe, Homologie und Kohomologie von Komplexen; projektive und injektive Auflösungen; derivierte Funktoren; Ext-Funktoren, Tor-Funktoren und Anwendungen **Basic literature:** 🕮 Rotman: *An Introduction to Homological Algebra* (Second Edition) 🕮 Weibel: *An introduction to homological algebra* **Recommended prior knowledge:** Algebra II			
Module assignment: • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Topologie			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAZD Management of IAG
Frequency: unregelmäßig			
Content: • Topologische Räume, stetige Abbildungen • Zusammenhang, Trennungsaxiome • Kompaktheit • Konstruktionen (insbes. Produkte, Quotienten) • Homotopie von Abbildungen • Fundamentalgruppen • Überlagerungen **Basic literature:** 📖 K. Jänich: *Topologie* 📖 G. Laures, M. Szymik: *Grundkurs Topologie* 📖 B.v. Querenburg: *Mengentheoretische Topologie* 📖 R. Stöcker, H. Zieschang: *Algebraische Topologie* **Recommended prior knowledge:** Analysis I und II			
Module assignment: • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

B.2 Algebraische Geometrie

Algebraische Flächen			**R**
Lecture type Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAG
Frequency: unregelmäßig			
Content: • birationale Abbildungen zwischen Flächen • Schnitttheorie • Kodaira Klassifikation **Basic literature:** 🕮 Beauville: *Complex algebraic surfaces*, CUP, 1983. **Recommended prior knowledge:** Algebraische Geometrie, hilfreich: Algebra II			
Module assignment: • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Algebraische Geometrie I			R
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAG
Frequency: annually, Winter semester			
Content: Einführung in Grundbegriffe der Algebraischen Geometrie, etwa affine und projektive Varietäten, Morphismen und rationale Abbildungen, Dimension, Glattheit und Singularitäten. Weitere mögliche Themen: • - Divisoren, Klassengruppen und Bezouts Theorem • - Differentialformen und der Satz von Riemann-Roch für Kurven • - Garben und (affine) Schemata **Basic literature:** 🕮 R. Hartshorne, Algebraic geometry, Springer 1983. 🕮 K. Hulek, Elementare Algebraische Geometrie, Springer 2012 🕮 I. R. Shafarevich, Basic Algebraic Geometry 1, Springer 2013 **Recommended prior knowledge:** Algebra I, Algebra II; hilfreich Complex analysis			
Module assignment: • Advanced module Bachelor Geometry • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Algebraische Geometrie II			R
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAG
Frequency: annually, Summer semester			
Content: Einführung in die Schematheorie: Garben, Schemata, Morphismen (separiert, eigentlich, projektiv), kohärente und quasi-kohärente Garben sowie deren Kohomologie **Basic literature:** 🕮 R. Hartshorne, Algebraic geometry, Springer 1983. 🕮 I. R. Shafarevich, Basic Algebraic Geometry 2, Springer 2013 **Recommended prior knowledge:** Algebraische Geometrie I			
Module assignment: • Advanced module Bachelor Geometry • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Algebraische Topologie			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAG
Frequency: unregelmäßig			
Content: • Homologietheorie, singuläre Homologie, Zellenkomplex • Kohomologietheorie • Poincaré Dualität **Recommended prior knowledge:** Algebra I, hilfreich: Algebra II			
Module assignment: • Advanced module Bachelor Geometry • Advanced module Bachelor Algebra, Number Theory, Discrete Mathematics • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Schnitttheorie / Intersection Theory			R
Lecture type Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IAG
Frequency: unregelmäßig			
Content: • algebraische Zykel und Chow Gruppen • Lokalisierungssequenz und Anwendungen (z. B. Chow Gruppen von projektiven Bündeln und Aufblasungen) • Divisoren • Vektorbündel und Chernklassen • Schnittprodukt • Anwendungen (z. B. in der enumerativen Geometrie) **Recommended prior knowledge:** Algebraische Geometrie I und II			
Module assignment: • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

B.3 Analysis

Funktionalanalysis			**R/A**
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Bauer, Escher, Schrohe, Walker
Frequency: annually			
Content: • Satz von Baire • Satz von Hahn-Banach, Konvexität • Prinzip der gleichmäßigen Beschränktheit • Satz von der offenen Abbildung, Graphensatz • Lineare Operatoren im Hilbertraum • Kompakte Operatoren • Unbeschränkte Operatoren **Recommended prior knowledge:** Analysis I-III, Linear algebra I			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Indextheorie			R
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Schrohe, Institute of Analysis
Frequency: unregelmäßig			
Content: • Fredholmoperatoren auf Banachräumen • Spektraltheorie kompakter Operatoren und die Fredholm-Alternative • Die Komponenten der Fredholm-Operatoren auf Hilberträumen • Toeplitz-Operatoren und deren Index • Indexberechnung withtels der Operatorspur • Pseudodifferentialoperatoren • Fedosovs Indexformel **Recommended prior knowledge:** Analysis I-III, Linear algebra I, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Analysis Subriemannscher Strukturen			R
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Bauer
Frequency: unregelmäßig			
Content: • Grundlagen der Analysis auf Manifolds • Subriemannsche Manifolds • Nicht-holonome Nebenbedingungen • Chow-Rashevskii Theorem • Geodäten in Subriemannscher Geometrie und Hamiltonscher Formalismus • Hörmander's Theorem und Hypoelliptizität • Subelliptische Wärmeleitungsgleichung **Recommended prior knowledge:** Analysis I-III, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Operatortheorie auf Hilberträumen			R
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Bauer
Frequency: unregelmäßig			
Content: • Schatten-p-Klassen • Bergman Räume und reproduzierende Kerne • Toeplitzoperatoren und Berezintransformation • Quantisierung und der Fockraum • Bergman-Metrik und Oszillationsräume • Hankeloperatoren • Toeplitzalgebra • Fredholmeigenschaft und der Index von Toeplitzoperatoren **Recommended prior knowledge:** Analysis I-III, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik			

Pseudodifferentialoperatoren			R/A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Bauer, Escher, Schrohe
Frequency: unregelmäßig			
Content: • Fouriertransformation, • temperierte Distributionen, • Sobolevräume, • Oszillatorintegrale, • Symbolklassen, • Stetigkeitseigenschaften und Kalkül, • Elliptizität und Parametrixkonstruktion, • Operatoren auf Manifolds, • Wellenfrontmenge **Recommended prior knowledge:** Analysis I-III, Linear algebra I, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Operatoralgebren			R
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Bauer
Frequency: unregelmäßig			
Content: • Banach und C* Algebren • Gelfand Transformation und Funktionalkalkül • Darstellungen und GNS-Konstruktion • Das Gelfand-Naimark Theorem • von Neumann Algebren • Der Bikommutantenssatz • Projektionen in von Neumann Algebren • Die relative Dimensionsfunktion und Klassifikation von Faktoren **Recommended prior knowledge:** Analysis I-III, Linear algebra I, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

B.4 Angewandte Analysis

Halbgruppen und Evolutionsgleichungen			R/A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Escher, Walker / IfaM
Frequency: alle ein bis zwei Jahre			
Content: • abgeschlossene Operatoren in Banachräumen • stark stetige und analytische Halbgruppen • Generatoren • Charakterisierungssätze • semilineare Cauchy Probleme **Recommended prior knowledge:** Analysis I-III, Linear algebra I und II			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Interpolationstheorie und Anwendungen			R/A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Escher, Walker / IfaM
Frequency: unregelmäßig			
Content: • reelle und komplexe Interpolation • Struktursätze (Reiteration, Dualität) • Interpolation von Lebesgue- und Sobolevräumen • gebrochene Potenzen • Interpolationstheorie elliptischer Randwertprobleme • Anwendungen auf Halbgruppentheorie **Recommended prior knowledge:** Halbgruppen und Evolutionsgleichungen or Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Nichtlineare Funktionalanalysis			R/A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Escher, Walker / IfaM
Frequency: alle ein bis zwei Jahre			
Content: • implizites Funktionentheorem in Banachräumen • Abbildungsgrad • Verzweigungstheorie • monotone Operatoren **Recommended prior knowledge:** Analysis I-III, Linear algebra I und II, Funktionalanalysis			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Partielle Differentialgleichungen			R/A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Bauer, Escher, Lankeit, Schrohe, Walker
Frequency: annually			
Content: • Charakteristikenmethode • Distributionen • Laplace-Gleichung, Maximumsprinzipien • Sobolevräume • Variationsmethoden, • Fouriertransformation • Wellengleichung • Wärmeleitungsgleichung **Recommended prior knowledge:** Analysis I-III, Linear algebra I und II			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Nichtlineare partielle/elliptische Differentialgleichungen			R/A
Lecture type Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Escher, Walker / IfaM
Frequency: unregelmäßig			
Content: • nichtlineare elliptische und parabolische Gleichungen • Fixpunktmethoden • Variationsmethoden • Kompaktheitsmethoden **Recommended prior knowledge:** Partielle Differentialgleichungen			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Qualitative Theorie gewöhnlicher Differentialgleichungen			R/A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Escher, Walker / IfaM
Frequency: annually			
Content: • Theorie dynamischer Systeme, • Invarianz, • Limesmengen, • Stabilität, Linearisierungen, • periodische Lösungen **Recommended prior knowledge:** Analysis I-III, Linear algebra I und II			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Bereich Reine Mathematik im Master Mathematik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Differentialgleichungen der mathematischen Biologie			R/A
Lecture type Bachelor und Master Mathematik, Master Lehramt	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Lankeit
Frequency: unregelmäßig			

Content:
Die Biologie versucht, Phänomene rund um lebende Objekte zu verstehen.
Neben experimentellen Herangehensweisen kann dabei auch der Einsatz mathematischer Werkzeuge und Methoden zum Verständnis beitragen.
Ein derartiges Werkzeug bilden Differentialgleichungen: Gleichungen, die einen Zusammenhang zwischen der Änderung einer (gesuchten) Funktion und ihrem momentanen Wert herstellen — und die sich an vielen Stellen in den Naturwissenschaften zur Beschreibung von Gesetzmäßigkeiten eignen.
In diesem Kontext soll diese Lecture einen Einblick in typische mathematische Modelle verwithteln, wobei der Schwerpunkt weniger auf deren Herleitung, sondern vor allem auf Methoden und Ergebnisse mathematischer Analysis gelegt wird.

Mögliche Themen:
Modelle zu Populationswachstum, Interaktion von (Teil-)Populationen,
Ökologische Modelle, starker und schwacher Wettbewerb, Symbiose, Räuber-Beute-Modell nach Lotka und Volterra, epidemiologische Modelle, Nervenimpulse
Existenz und Eindeutigkeit von Lösungen gewöhnlicher Differentialgleichungen, Fortsetzbarkeitskriterien, Langzeitverhalten von Lösungen autonomer skalarer Differentialgleichungen, Vergleichssatz für gewöhnliche Differentialgleichungen und Anwendungen, Vergleichssatz für kooperative Systeme, periodische Lösungen, Lyapunovfunktionen, Stabilität, Invariante Mengen, Satz von Poincaré-Bendixson

Basic literature:

-

Recommended prior knowledge:
Analysis I und II, Linear algebra I

Module assignment:
- Advanced module Bachelor Analysis
- Wahlmodul Reine/Angewandte Mathematik im Master
  Master Lehramt: Fachwissenschaftliche Vertiefung („Spezielle Themen der Analysis fürs Lehramt")

Partielle Differentialgleichungen der mathematischen Biologie			R/A
Lecture type Bachelor und Master Mathematik, Master Lehramt	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Lankeit
Frequency: unregelmäßig			
Content: Anhand von Beispielen, die der Biologie entstammen, sollen in dieser Veranstaltung Aussagen über qualitative Eigenschaften von Lösungen partieller Differentialgleichungen nachgewiesen werden. Einen Höhepunkt wird dabei die Betrachtung von Systemen parabolischer Differentialgleichungen bilden, welche Chemotaxis — die entsprechend der Konzentration einer chemischen Signalsubstanz gerichtete Bewegung von Zellen — beschreiben und nicht zuletzt wegen ihrer mathematischen Struktur noch immer ein aktuelles Thema auf dem Gebiet der Analysis partieller Differentialgleichungen bilden. Mögliche Themen: Räumliche Ausbreitung von Arten Reaktions-Diffusions-Systeme Musterenstehung withtels Turing-Mechanismus Chemotaxis Diffusionsgleichungen, Travelling Wave Solutions, Vergleichssatz für parabolische Differentialgleichungen, Langzeitverhalten und Blow-Up in Systemen von Reaktions-Diffusions-Gleichungen, Energie-Argumente, Untersuchung des Keller-Segel-Systems **Basic literature:** - **Recommended prior knowledge:** Analysis I, II und III, Linear algebra I und II			
Module assignment: • Advanced module Bachelor Analysis • Wahlmodul Reine/Angewandte Mathematik im Master			

Variationsrechnung und optimale Steuerung			R/A
Calculus of Variations and Optimal Control			
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Alden Waters
Frequency: unregelmäßig			

Content:
- Variationsprinzip, Euler-Lagrange Gleichung
- Beltrami's Identität
- Bedingungen für Minimalität
- Euler-Lagrange Gleichung
- Methode der Lagrange Multiplikatoren
- Minimalprinzip
- Variable Endzeit
- LQ Problem
- dynamische Programmierung in diskreter Zeit
- Bellman's Gleichung
- Riccatische Differentialgleichung
- Quadratische Ergänzung für das LQ-Problem
- LQ Problem und unendlicher Horizont, algebraische Riccati-Gleichung
- Relationen with invarianten Unterräumen Hamiltonscher Matrizen
- Definition der (asymptotischen) Stabilität
- Lyapunov's zweite Stabilisierungsmethode
- Invarianzprinzip von LaSalles
- Lyapunov's erste Methode
- Stabilisierung

Basic literature:

-

Recommended prior knowledge:
Analysis I,II,II, Linear algebra I, Partielle Differentialgleichungen

Module assignment:
- Advanced module Bachelor Analysis
- Wahlmodul Reine/Angewandte Mathematik im Master

Wellengleichungen auf Raumzeiten			R/A
Wave equations on spacetimes			
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Alexander Strohmaier
Frequency: unregelmäßig			

Content:
- LorentzManifolds und Kausalität
- Global hyperbolische Raumzeiten
- Normal hyperbolische Operatoren
- Ultrastatische Raumzeiten und spektrale Konstruktion von Lösungen
- Riesz Distributionen
- Hadamard Parametrix
- Existenz und Eindeutigkeit von Fundamentallösungen
- Singularitäten von Fundamentallösungen

Basic literature:

-

Recommended prior knowledge:

Analysis I,II,III, Funktionalanalysis, Linear algebra I, Partielle Differentialgleichungen

Module assignment:
- Advanced module Bachelor Analysis
- Wahlmodul Reine/Angewandte Mathematik im Master

B.5 Numerische Mathematik und Optimierung

Einführung in die Adaptive Finite-Elemente-Methode			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: alle zwei bis drei Jahre			
Content: • Adaptive Gitterverfeinerung für FEM • A posteriori Fehleranalysis • Fehlerschätzer: (u.a. residuale) • Konvergenz **Basic literature:** 🕮 Ainsworth/Oden: *A posteriori error estimation in finite element analysis.* Wiley 2000. 🕮 Nochetto/Siebert/Veeser: *Theory of adaptive finite element methods: an introduction.* In: Multiscale, nonlinear and adaptive approximation, 409–542, Springer, 2009. **Recommended prior knowledge:** Numerische Mathematik I und Numerik Partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

hp-Finite Element Methoden			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: alle zwei bis drei Jahre			
Content: • Wahl der Basisfunktionen/ Orthogonale Polynome • Assemblierung: Sum factorization • Löser • Konvergenz: Beweis der exponentiellen Konvergenz **Basic literature:** 📖 Schwab: *p- and hp-finite element methods.* Clarendon 1998. **Recommended prior knowledge:** Numerische Mathematik I und Numerik Partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Lineare Optimierung			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: regelmäßig alle zwei bis drei Jahre			
Content: • Simplexmethode • Polyedertheorie • Alternativsätze • Dualität **Basic literature:** 📖 V. Chvátal: *Linear Programming* **Recommended prior knowledge:** Numerische Mathematik I, Algorithmisches Programmieren			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Multigrid und Gebietszerlegung			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: alle zwei bis drei Jahre			

Content:

- vorkonditionierte Iterationsverfahren (Richardson, Jacobi)
- Multigrid (für Finite-Differenzen-Verfahren, Finite Elemente)
- Multilevel-Methoden (Additiv- und Multiplikativ-Schwarz-Verfahren)
- Gebietszerlegungsmethoden (alternierendes Schwarz-Verfahren)

Basic literature:

📖 Toselli/Widlund: *Domain decomposition methods—algorithms and theory.* Springer, 2005.

Recommended prior knowledge: Numerische Mathematik I, evtl. Numerik Partieller Differentialgleichungen

Module assignment:

- Advanced module Bachelor Numerik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Nichtlineare Optimierung I			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IfAM
Frequency: regelmäßig alle zwei bis drei Jahre			
Content: • Gradientenverfahren, Newton-Verfahren, Line Search, Trust Region • Theorie der beschränkten Optimierung: KKT-Bedingungen, ... • Quadratische Optimierung: KKT-Faktorisierungen, Active-Set-Methode • Maratos-Effekt, Merit-Funktionen, SQP-Methode **Basic literature:** 🕮 J. Nocedal, S. Wright: *Numerical Optimization*, 2. Aufl. **Recommended prior knowledge:** Numerische Mathematik I und II, Algorithmisches Programmieren			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Nichtlineare Optimierung II			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points** 10	**Responsibility** Management of IfAM
Frequency: regelmäßig alle zwei bis drei Jahre			
Content: • nichtlineare CG-Verfahren • Techniken für hochdimensionale Modelle • innere-Punkte-Methoden • weitere Themen **Basic literature:** 🕮 J. Nocedal, S. Wright: *Numerical Optimization*, 2. Aufl. **Recommended prior knowledge:** Nichtlineare Optimierung I			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Numerik Partieller Differentialgleichungen			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IfAM
Frequency: annually			
Content: • Galerkin-Verfahren für elliptische Randwertprobleme • Finite-Element-Räume • a-posteriori-Fehlerschätzer • Verfahren für parabolische und hyperbolische Differentialgleichungen **Basic literature:** 📖 P. Knabner, L. Angermann: *Numerik partieller Differentialgleichungen* **Recommended prior knowledge:** Numerische Mathematik I			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Numerische Methoden der Kontinuumsmechanik			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IfAM
Frequency: alle ein bis zwei Jahre			
Content: • Modellierung: Elastizität und Strömungsmechanik • Diskretisierung: gemischte Finite Elemente • Fehlerschätzungen für Stokes **Basic literature:** 🕮 Brezzi/Fortin: *Mixed and hybrid finite element methods.* Springer 1991 **Recommended prior knowledge:** Numerische Mathematik I und Numerik Partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Numerische Methoden für gewöhnliche Differentialgleichungen			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: unregelmäßig			
Content: • Einschrittmethoden • Numerische Stabilität • Differentiell-algebraische Gleichungen • Galerkin-Verfahren • Schießverfahren • Variationsmethoden **Basic literature:** 🕮 Rannacher: *Einführung in die Numerische Mathematik*, Heidelberg University Publishing, 2017. **Recommended prior knowledge:** Numerische Mathematik I und II			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Optimierung with partiellen Differentialgleichungen			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: unregelmäßig			
Content: • Linear quadratische Optimalsteuerung: • Existenz und Eindeutigkeit eines Minimums • adjungierter Zustand • Diskretisierung und Optimierung: FEM **Basic literature:** 🕮 Troeltzsch: *Optimal control of partial differential equations.* AMS, 2010. **Recommended prior knowledge:** Numerische Mathematik I und Numerik Partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Unstetige Galerkinverfahren			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Management of IfAM
Frequency: unregelmäßig			
Content: • Grundkonzepte • DG für stationäre Advektion (Flüsse/Upwinding) • DG für Nichtstationäre PDE's 1. Ordnung • DG für elliptische Aufgaben (SIP) **Basic literature:** 🕮 Ern/di Pietro: *Mathematical aspects of discontinuous Galerkin methods.* Springer 2012. **Recommended prior knowledge:** Numerische Mathematik I und Numerik Partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Multikriterielle Optimierung: Theorie und Algorithmen			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Geschäftsleitung IFAM
Frequency: alle ein bis zwei Jahre			
Content: • Grundlagen der Multikriteriellen Optimierung • Lösungskonzepte für multikriterielle Optimierungsaufgaben im Sinne von Edgeworth und Pareto • Skalarisierungsmethoden • Optimalitätsbedingungen • Numerische Algorithmen • Anwendungen (Portfoliooptimierung, Vektor-Approximationstheorie, Standorttheorie, Physik, ...) **Basic literature:** • Jahn: Vector Optimization - Theory, Applications, and Extensions, Springer 2011. • Ehrgott: Multicriteria Optimization, Springer 2005. **Recommended prior knowledge:** Analysis I und II, Linear algebra I und II			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Numerische Methoden für gekoppelte, variationelle Systeme with Ungleichungsbedingungen / Numerical methods für coupled variational inequality systems			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Geschäftsleitung IFAM
Frequency: 3 Jahre			

Content:

This course is devoted to numerical methods for coupled variational inequality systems. It means, we consider problems which are basically a PDE system with a coupling and a variational inequality constraint that has to be fulfilled.

- In part I, we start with two representative examples: the obstacle problem and fluid-structure interaction and refresh numerical tools as FEM, time-stepping schemes, nonlinear and linear solvers, inequality constraints as well as the basic definitions of interfaces.
- In part II, we classify CVISs, namely nonstationary, nonlinear, coupled differ- ential equations subject to inequality constraints.
- In part III of this course, we focus on coupled problems and multiphysics PDEs.
- In part IV, we discuss different approaches to handle inequality constraints numerically; from simple penalization to Lagrange multipliers.
- All concepts are substantiated with algorithms and numerical tests in the theoretical and practical exercises.

Or see http://www.thomaswick.org/CVIS_SoSe21/announcement_CVIS_SoSe2021.pdf

Basic literature:

- T. Wick; Multiphysics Phase-Field Fracture: Modeling, Adaptive Discretizations, and Solvers Radon Series on Computational and Applied Mathematics, Band 28, de Gruyter, 2020.

Recommended prior knowledge:

Numerik 1, Numerik 2, Numerik partieller Differentialgleichungen

Module assignment:

- Advanced module Bachelor Numerik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Numerische Methoden für Algorithmische Systeme und neuronale Netze			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Geschäftsleitung IFAM
Frequency: alle zwei bis drei Jahre			

Content:
Algorithmische Systeme, Numerische Konzepte, Wahrscheinlichkeitsrechnung, Statistik, Deep Learning in neuronalen Netzen, Maschinelles Learnen im Wissenschaftlichen Rechnen

Basic literature:
https://www.repo.uni-hannover.de/handle/123456789/11992

Recommended prior knowledge:
Numerik I

Module assignment:
- Advanced module Bachelor Numerik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Space-time methods			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Geschäftsleitung IFAM
Frequency: alle zwei bis drei Jahre, Winter semester			
Content: Unstetige Galerkinverfahren (dG), • space-time Modellierung, • space-time Diskretisierung, • ggf. ziel-orientierte Fehlerschätzung, • ggf. Modelreduktion, • ggf. Anwendung auf Multiphysikprobleme **Basic literature:** • T. Wick; Space-time Mehods: Formulations, Discretization, Solution, Goal-Oriented Error Control and Adaptivity **Recommended prior knowledge:** Numerik 1, Numerik 2, Numerik partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

FEM-C++ - Programming in deal.II			A
Lecture type Bachelor und Master	**SWS** 2+2	**Credit Points:** 5	**Responsibility** Geschäftsleitung IFAM
Frequency: alle zwei bis drei Jahre			
Content: • Programmierung in C++ von Finite-Elemente-Verfahren, • Eigene Implementierung von Grund auf, • ggf. Einfuehrung in die Finite-Elemente-Bibliothek deal.II **Basic literature:** • C++: https://www.repo.uni-hannover.de/handle/123456789/11674 und fuer Grundlagen Finite-Elemente siehe Kurs „Numerik partieller Differentialgleichungen" **Recommended prior knowledge:** Numerik partieller Differentialgleichungen			
Module assignment: • Advanced module Bachelor Numerik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Numerische Methoden für Phasenfeld-RIssprobleme			A
Lecture type Bachelor und Master	**SWS** 2+3	**Credit Points:** 5	**Responsibility** Geschäftsleitung IFAM

Frequency: alle drei Jahre

Content:
This course is devoted to numerical modeling of fracture processes modeled in terms of a variational phase-field method. Using this approach, roughly-speaking, lower-dimensional fractures in a given displacement field are represented with the help of a smoothed indicator function, the so-called phase-field variable. • In part I, we briefly recapitulate mathematical modeling, including advantages and shortcomings of the phase-field fracture approach, followed by properties on the continuous level. • In part II, we concentrate on classical numerical aspects. First, we introduce Ambrosio-Tortorelli elliptic functionals to approximate the lower-dimensional crack path in the same dimension as the displacement field. Second, we focus on the treatment of crack irreversibility. Third, discretizations in time and space are considered. Fourth, we address the numerical solution of the nonlinear and linear subproblems. • In part III of this course, we focus special topics such as on the crack width and crack volume computation, and discuss further numerical aspects of enforcing the crack irreversibility constraint. Also, we briefly discuss pressurized fracture. • All concepts are substantiated with algorithms and numerical tests in the theoretical and practical exercises.

See http://www.thomaswick.org/links/ankuendigung_vpff_Wick_Mang_Noii.pdf

Basic literature:

- T. Wick; Multiphysics Phase-Field Fracture: Modeling, Adaptive Discretizations, and Solvers Radon Series on Computational and Applied Mathematics, Band 28, de Gruyter, 2020.

Recommended prior knowledge:
Numerik 1, Numerik 2, Numerik partieller Differentialgleichungen

Module assignment:
- Advanced module Bachelor Numerik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

B.6 Differentialgeometrie

Riemannsche Geometrie			**R**
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG
Frequency: annually, Winter semester			
Content: • Riemannsche Metriken • Parallelverschiebung und Geodäten • Exponentialabbildung, Injektivitätsradius und Schnittort • Geodätische Vollständigkeit, der Satz von Hopf-Rinow • Zusammenhänge auf Vektorbündeln • Krümmung eines Zusammenhangs • Der Riemannsche Krümmungstensor des Levi-Civita-Zusammenhangs, erste und zweite Bianchi-Gleichung • Erste und zweite Variation von Länge und Energie einer Kurve • konjugierte Punkte, Jacobi-Felder • symmetrische und lokal symmetrische Räume • Harmonische Differentialformen • Zerlegungssatz von Hodge **Basic literature:** 🕮 Jost, Jürgen: *Riemannian Geometry and Geometric Analysis*, Springer Verlag 🕮 Gallot, Hulin, Lafontaine: *Riemannian Geometry*, Universitext, Springer Verlag 🕮 Spivak, M.: *A comprehensive introduction to differential geometry I-V*, Publish or Perish **Recommended prior knowledge:** Manifolds			
Module assignment: • Advanced module Bachelor Geometry • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Komplexe Differentialgeometrie			**R**
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG
Frequency: annually, Summer semester			
Content: • Komplexe Manifolds • fast komplexe und komplexe Strukturen, Nijenhuis-Tensor und Integrabilität • Herwithesche Manifolds, die Klassifikation von Gray und Hervella			

- Kähler-Manifolds
- Dolbeault-Operatoren, Zerlegungssatz von Dolbeault
- Hodge-Zahlen, Serre-Dualität
- Chern-Klassen, -Formen und -Zahlen
- Satz von Gauß-Bonnet-Chern
- Calabi-Yau-Manifolds

Basic literature:

- 🕮 Kobayashi S., Nomizu, K.: Foundations of differential geometry, Vol. II, Wiley Classics Library

Recommended prior knowledge: Manifolds, Complex analysis

Module assignment:

- Advanced module Bachelor Geometry
- Wahlmodul Bereich Reine Mathematik im Master Mathematik

Symplektische Geometrie			R
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG

Frequency: unregelmäßig

Content:

- Lineare symplektische Geometrie
- symplektische Manifolds
- Kotangentialbündel und koadjungierte Orbits als symplektische Manifolds
- Mosers Prinzip und der Satz von Darboux
- Hamiltonsche Vektorfelder, Poisson-Klammer, Hamiltonsche Wirkungen und Impulsabbildung
- Kapazitäten
- pseudoholomorphe Kurven
- Modelle der klassischen Mechanik
- Legendre-Transformation

Basic literature:

- 🕮 Aebischer, Borer, Kälin, Leuenberger, Reimann: *Symplectic geometry*, Progress in Mathematics, Birkhäuser, 1994
- 🕮 McDuff, Salamon; *Introduction to symplectic topology*, Oxford Mathematical Monographs, The

Clarendon Press, Oxford University

Recommended prior knowledge: Manifolds

Module assignment:

- Advanced module Bachelor Geometry
- Wahlmodul Bereich Reine Mathematik im Master Mathematik

Differentialtopologie			**R**
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG

Frequency: unregelmäßig

Content:

- Reguläre und kritische Punkte und Werte
- Die Sätze von Sard und Brown
- Index von Vektorfeldern, Abbildungsgrade, der Satz von Poincare-Hopf
- Morse-Theorie und Morse-Ungleichungen
- Relative Kohomologietheorie
- Lange exakte Sequenzen, Mayer–Vietoris-Sequenz

Basic literature:

- 🕮 Milnor, John W.: *Topology from the differential view point*, Princeton University Press
- 🕮 Milnor, John W.: *Morse theory*, Princeton University Press

Recommended prior knowledge: Analysis III, Manifolds

Module assignment:

- Advanced module Bachelor Geometry
- Wahlmodul Bereich Reine Mathematik im Master Mathematik

Eichfeldtheorie			R
Lecture type Bachelor, Master	**SWS** 2+1*	**Credit Points:** 5	**Responsibility** Management of IDG
Frequency: unregelmäßig			
Content: • Zusammenhänge auf Hauptfaserbündeln und deren Krümmung • Eichtransformationen • Yang-Mills-Funktional und Yang-Mills-Gleichung • selbstduale und invariante Zusammenhänge • nicht-minimale Yang-Mills-Zusammenhänge • magnetische Monopole und Wirbel **Recommended prior knowledge:** Manifolds			
Module assignment: • Advanced module Bachelor Geometry • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

Geometrische Evolutionsgleichungen (Geometric evolution equations)			R
Lecture type Bachelor, Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Management of IDG
Frequency: unregelmäßig (englisch)			
Content: • Variational problems on manifolds • Harmonic map heat flow • Mean curvature flow, Lagrangian mean curvature flow • Ricci flow, Sasaki-Ricci flow • Hamilton's maximum principle for tensors • Short and longtime existence and convergence • Singularities, Self-similar solutions, solitons, monotonicity formulas **Recommended prior knowledge:** Analysis III, Manifolds, Riemannsche Geometrie			
Module assignment: • Advanced module Bachelor Geometry • Wahlmodul Bereich Reine Mathematik im Master Mathematik			

B.7 Mathematische Stochastik

Financial Mathematics 1			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik
Frequency: annually			
Content: • Arbitrage Theory • Preferences • Optimality and Equilibrium • Risk Measures **Basic literature:** 🕮 H. Föllmer& A. Schied: *Stochastic Finance*, de Gruyter, Berlin/New York, 2004. **Recommended prior knowledge:** Mathematische Stochastik II			
Module assignment: • Advanced module Bachelor Stochastik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Financial Mathematics 2			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik
Frequency: annually			
Content: • Stochastic integration, • Ito calculus, • stochastic differential equations; • financial market models in continuous time **Basic literature:** 🕮 M. Musiela & R. Rutkowski: *Martingale Methods in Financial Modelling*, Springer, 2005. **Recommended prior knowledge:** Mathematische Stochastik II, Financial Mathematics 1			
Module assignment: • Advanced module Bachelor Stochastik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Actuarial Mathematics 1			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik
Frequency: annually			

Content:
Non-Life Insurance, Life & Health Insurance: Concepts, models, statistical and ML techniques.

The lecture is divided into Actuarial Mathematics 1 and Actuarial Mathematics 2.

Basic literature:

- 🕮 T. Mack: *Schadenversicherungsmathematik*, VVW Karlsruhe, 2002.
- 🕮 K. Schmidt: *Versicherungsmathematik*, Springer, 2006.
- 🕮 M. Koller: *Stochastische Modelle in der Lebensversicherungsmathematik*, Springer, 2000.
- 🕮 R. Norberg: *Basic Life Insurance Mathematics*, LSE, 2002.

Recommended prior knowledge: Mathematische Stochastik II

Module assignment:

- Advanced module Bachelor Stochastik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Actuarial Mathematics 2			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik
Frequency: annually			

Content:
Non-Life Insurance, Life & Health Insurance: Concepts, models, statistical and ML techniques.

The lecture is divided into Actuarial Mathematics 1 and Actuarial Mathematics 2.

Basic literature:

- 🕮 T. Mack: *Schadenversicherungsmathematik*, VVW Karlsruhe, 2002.
- 🕮 K. Schmidt: *Versicherungsmathematik*, Springer, 2006.
- 🕮 M. Koller: *Stochastische Modelle in der Lebensversicherungsmathematik*, Springer, 2000.
- 🕮 R. Norberg: *Basic Life Insurance Mathematics*, LSE, 2002.

Recommended prior knowledge: Mathematische Stochastik II, Actuarial Mathematics I

Module assignment:

- Advanced module Bachelor Stochastik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Stochastic Simulation			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik
Frequency: annually			
Content: • Generating Random Numbers and Random Variables • Generating Sample Paths • Variance Reduction Techniques • Quasi-Monte Carlo • Discretization Methods • Estimating Sensitivities • Markov Chain Monte Carlo **Basic literature:** 🕮 S. Asmussen & P. Glynn: *Stochastic Simulation*, Springer, 2007. 🕮 P. Glasserman: *Monte Carlo Methods in Financial Engineering*, Springer, 2004. **Recommended prior knowledge:** Mathematische Stochastik I und II			
Module assignment: • Advanced module Bachelor Stochastik • Wahlmodul Bereich Angewandte Mathematik im Master Mathematik			

Quantitative Risk Management			A
Lecture type Bachelor und Master	**SWS** 4+2	**Credit Points:** 10	**Responsibility** Institute of Versicherungs- und Finanzmathematik

Frequency: annually

Content:

The course deals with quantitative risk management in finance, insurance, engineering and computer science. This includes linear models & time series, modeling dependence, risk measures, point processes, Bayesian statistics & credibility theory, enterprise risk management, and machine learning

Basic literature:

- 🕮 T. Bielecki & M. Rutkowski: *Credit Risk*, Springer, 2004.
- 🕮 L. Fahrmeir, T. Kneib, S. Lang & B. Marx: *Regression*, Springer, 2013.
- 🕮 H. Föllmer & A. Schied: *Stochastic Finance*, De Gruyter, 2016.
- 🕮 J. Franke, W. Härdle & C. Hafner: *Statistics of Financial Markets*, Springer, 2019.
- 🕮 A. J. McNeil, R. Fey, and P. Embrechts: *Quantitative Risk Management,* Princeton University Press, 2015.

Recommended prior knowledge: Mathematische Stochastik I und II

Module assignment:

- Advanced module Bachelor Stochastik
- Wahlmodul Bereich Angewandte Mathematik im Master Mathematik

Nichtparametrische Testverfahren			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Marco Meyer
Frequency: unregelmäßig			
Content: Beste Tests im nichtparametrischen Kontext, Suffizienz und Vollständigkeit, Permutationstests, Anpassungstests, Bootstrap **Basic literature:** 🕮 L. Rüschendorf: "Mathematische Statistik"; A. Tsybakov: "Introduction to Nonparametric Estimation" **Recommended prior knowledge:** Mathematische Stochastik I+II			
Module assignment: • Spezialisierung Stochastik Bachelor • Wahlmodul Bereich Angewandte Mathematik Master			

Mathematische Statistik			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Marco Meyer
Frequency: unregelmäßig			
Content: • Schätz- und Testtheorie, Gütemaße für Schätzer, Optimalität von Schätzern, Cramér-Rao-Schranke, Suffizienz, Bayes- und ML-Methode, Neyman-Pearson-Testtheorie **Basic literature:** 🕮 L. Rüschendorf: "Mathematische Statistik"; A.W. van der Vaart: "Asymptotic Statistics" **Recommended prior knowledge:** Mathematische Stochastik I+II			
Module assignment: • Spezialisierung Stochastik Bachelor • Wahlmodul Bereich Angewandte Mathematik Master			

Zeitreihenanalyse			A
Lecture type Bachelor und Master	**SWS** 2+1	**Credit Points:** 5	**Responsibility** Marco Meyer
Frequency: unregelmäßig			

Content:
Grundlegende Zeitreihenmodelle, Trend- und Saisonbereinigung, Stationarität, ARMA-Modelle, lineare Vorhersage

Basic literature:

- 🕮 J.-P. Kreiß, G. Neuhaus: "Einführung in die Zeitreihenanalyse"; P. Brockwell, R.A. Davis: "Time Series: Theory and Methods"

Recommended prior knowledge
Mathematische Stochastik I+II

Module assignment:

- Spezialisierung Stochastik Bachelor
- Wahlmodul Bereich Angewandte Mathematik Master

Ansprechpartner für Studieninformation und –beratung und weitere Angebote

Viele Fragen zum Studium sollten sich durch Lektüre dieses Modulkatalogs klären lassen. Es gibt aber auch Fragen, die besser in einem Beratungsgespräch zu beantworten sind. Dafür stehen Ihnen die folgenden Personen und Einrichtungen zur Verfügung.
In diesem Kapitel werden außerdem weitere Institutionen und Einrichtungen vorgestellt, die Angeboten für Studierende der Leibniz Universität Hannover zur Verfügung stellen.

Ansprechpartner innerhalb der Fakultät

Studienorganisation

Informationen zur Studienorganisation finden Sie in dieser Broschüre, in den aktuellen Prüfungsordnungen und unter www.maphy.uni-hannover.de/de/studium.
Bei individuellen Fragen und Problemen können Sie sich an die Studiengangskoordination wenden.
Die **Studiengangskoordination** ist die zentrale Anlaufstelle in Studienangelegenheiten. Sie fungiert als kommunikative und organisatorische Schnittstelle zwischen Studierenden und Lehrenden. Die Studiengangskoordination ist dawith insbesondere für die Beratung von Studierenden zuständig.

Studiengangskoordination

Dipl.-Ing. Axel Köhler (Raum A121)	- 5450
Dipl.-Soz.Wiss Miriam Redlich (Raum A102)	- 19367
Dr. Katrin Radatz (Raum A122)	- 14594
Appelstraße 11A, 30167 Hannover	sgk@maphy.uni-hannover.de

Fachstudienberatung

Eine individuelle Studienberatung wird grundsätzlich von allen Professorinnen und Professorenangeboten. Als zentraler Fachberater steht darüber hinaus Prof. Steinbach zur Verfügung. Eine Fachstudienberatung sollte besonders in den folgenden Fällen in Anspruch genommen werden:

- vor der Wahl von Studienschwerpunkten, Prüfungsfächern und dem Arbeitsgebiet für die Bachelor- or Masterarbeit
- nach nicht bestandenen Prüfungen
- bei Studienfach-, Studiengangs- or Hochschulwechsel.
- bei der Planung eines Studienaufenthalts im Ausland

Die aktuellen Sprechstunden der Fachberaterinnen und Fachberater lassen sich meistens im Internet finden or können telefonisch, per Post or per E-Mail erfragt werden.

Prof. Dr. Marc Steinbach	mcs@ifam.uni-hannover.de

Welfengarten 1 (Raum e336) Tel.: 0511-762-2359
30167 Hannover

BAföG-Beauftragter

Wenn Sie BAföG beziehen, müssen Sie wahlweise nach dem 3. or 4. Semester eine Bescheinigung der Fakultät vorlegen, dass Sie in Regelzeit studieren. Wenden Sie sich hierzu an den BAföG-Beauftragten

Dr. Lutz Habermann *habermann@math.uni-hannover.de*
Welfengarten 1 (Raum c420) Tel.: 0511-762-5534
30167 Hannover

Fachschaft Mathematik und Physik

www.fsr-maphy.uni-hannover.de

Erfahrungsgemäß erhalten Studierende viele Informationen am schnellsten von Kommilitonen/innen aus dem gleichen or höheren Semester. Die Fachschaft bietet Kontaktmöglichkeiten zu Ansprechpartnerinnen und -partnern, die in den meisten Fällen - vor allem aufgrund ihrer eigenen Studienerfahrung - viele Fragen klären or an die jeweils zuständige Beratungsstelle verweisen können. Die jeweils aktuellen Ansprechpartnerinnen und -partner sind im Internet zu finden.

Die hauptsächliche Aufgabe des Fachschaftsrats ist die Vertretung der studentischen Interessen in den Gremien der Fakultät. So wirkt er über die studentischen Vertreter/innen z.B. bei der Gestaltung der Prüfungsordnungen with und kann bei der Neueinstellung von Professorinnen und Professoren in den Berufungskommissionen withentscheiden. Er wirkt aber auch in fakultätsübergreifenden Gremien with.

Darüber hinaus bietet die Fachschaft auch folgendes an:

- Orientierungseinheiten und gemeinsames Frühstück für alle Studienanfängerinnen und -anfänger in der ersten Woche vor dem Beginn des Winter semesters
- Kennenlern-Freizeit am Wochenende für Studierende im ersten Semester
- Beratung zu den Mathematik-, Physik-, und Meteorologiestudiengängen
- Hilfe bei Problemen im Studium / with Dozenten/-innen / Lecturesstruktur
- Arbeitsräume with einer kleinen Lehrbuchsammlung
- eine Sammlung von Klausuren und Prüfungsprotokollen der letzten Jahre
- die Fachschaftszeitung Phÿsemathenten
- ein Fußballteam in dem alle interessierten Studierenden der Fakultät withspielen können
- das Grillfest alle zwei Jahre
- „Zahlendre3her" Partys
- Erstsemesterparty zum Kennenlernen in der OE-Woche
- Regelmäßige Spieleabende sowie eine große Spielesammlung der Fachschaft

Fachschaft Mathematik / Physik *info@fsr-maphy.uni-hannover.de*

Welfengarten 1 (Raum d 414) Tel.: 0511-762-7405
30167 Hannover

Wer selbst einmal Lust hat, Ansprechpartner zu werden, ist von der Fachschaft herzlich eingeladen, einfach an einer Sitzung des Fachschaftsrates teilzunehmen. Die Sitzungen sind im Semester immer montags um 18.15 Uhr im Fachschaftsraum. Da der Fachrat ein offener Rat ist, ist jeder Studierender der Fakultät auf den Sitzungen stimmberechtigt. Dies gilt für alle Abstimmungen, die sich nicht with Finanzen or Änderungen der Geschäftsordnung befassen.

Prüfungsausschuss

Der Ablauf des Studiums, insbesondere die zu erbringenden Leistungen, wird durch die jeweiligen Prüfungsordnungen geregelt (see appendix). Der Prüfungsausschuss achtet darauf, dass die Bestimmungen der Prüfungsordnung eingehalten werden. Er entscheidet über Fragen der Anerkennung von Leistungen wie auch in Widerspruchsverfahren. Ein Anliegen für den Prüfungsausschuss wird in der Regel direkt an den Vorsitzenden des Prüfungsausschusses gerichtet.

Prof. Dr. Knut Smoczyk (Vorsitzender) *PA-Mathematik@math.uni-hannover.de*
Welfengarten 1 (Raum a415) Tel.: 0511-762-4253
30167 Hannover

Für Entscheidungen zu den Lehramtsstudiengängen sind eigene Prüfungsausschüsse zuständig, die von der Leibniz School of Education betreut werden.

Zentrale Ansprechpartner

Service Center www.uni-hannover.de/servicecenter

Das Service Center der Leibniz Universität Hannover ist die zentrale Anlaufstelle für Studierende und Studieninteressierte. Hier arbeiten Witharbeiterinnen und Witharbeiter aus verschiedenen zentralen Einrichtungen, die Fragen rund um das Studium beantworten und die Orientierung an der Leibniz Universität Hannover erleichtern. Während der Öffnungszeiten stehen Witharbeiter folgender Bereiche zur Beratung zur Verfügung:

- Akademisches Prüfungsamt
- BAFöG-Beratung
- Hochschulbüro für Internationales
- Immatrikulationsamt
- Psychologisch Therapeutische Beratung
- Zentrale Studienberatung

Kontakt: ServiceCenter Leibniz Universität Hannover	*studium@uni-hannover.de*
Welfengarten 1	Tel.: 0511-762-2020
30167 Hannover	
Öffnungszeiten:	Mo. – Fr: 10.00 - 14.00 Uhr

Zentrale Studienberatung (ZSB)

www.zsb.uni-hannover.de

Die Zentrale Studienberatung ist Anlaufstelle für alle Studierenden der Hochschulen Hannovers. Es gibt verschiedene Beratungsformen:

- Offene Sprechstunde: Einzelberatung in vertraulicher Atmosphäre ohne vorherige Terminvereinbarung; Anmeldung in der Infothek im ServiceCenter (Do. 14.30-17.00)
- Nach Terminvereinbarung: Einzelberatung in vertraulicher Atmosphäre Terminvereinbarung über die Servicehotline der Leibniz Universität Hannover (0511-762-2020)
- Kurzberatung: Kurze Erstinformationsgespräche (Dauer: bis zu 10 Minuten) in der Infothek des ServiceCenter im Hauptgebäude (Mo.- Fr. 10.00 bis 14.00 Uhr)

Die Beratung erfolgt zu allen Fragen und Problemen, die in engerem or weiterem Zusammenhang with dem Studium stehen; so z.B. bei:

- Studienfachwechsel
- Hochschulwechsel
- Prüfungsproblemen
- beruflichen Perspektiven nach dem Studium

Zentrale Studienberatung	*studienberatung@uni-hannover.de*
Welfengarten 1	Tel.: 0511-762-2020

30167 Hannover

Studieren with Handicap und/or einer chronischen Erkrankung

Ein Studium with einer gesundheitlichen Beeinträchtigung or auch z.B. Legasthenie kann Schwierigkeiten with sich bringen und manche Fragen aufwerfen, das gilt für Studierende im ersten Semester ebenso wie für Studierende kurz vor dem Abschluss. Die LUH hält verschiedene Angebote vor, with denen die Studierenden unterstützt werden, so können Hilfswithtel ausgeliehen, Nachteile in Prüfungen ausgeglichen werden und persönliche Beratung bei vielfältigen Fragen und Problemen in Anspruch genommen werden, so z.B.:

- Wie kann ich with an der Universität besser zurechtkommen?
- Organisation des Studiums
- Nachteilsausgleich/Prüfungsprobleme
- Wie geht es nach dem Studium weiter?
- ... und was Sie persönlich „umtreibt"....

Die Beauftragte für Studierende with handicap/chron. Erkrankung hilft Ihnen gerne weiter:
Christiane Stolz. 0511/762-3217, christiane.stoilz@zuv.uni-hannover.de

Akademisches Prüfungsamt

www.uni-hannover.de/pruefungsamt

Die Prüfungen werden im zentralen Akademischen Prüfungsamt der Universität in Zusammenarbeit with dem Studiendekanat bzw. dem jeweils zuständigen Prüfungsausschuss organisiert. Das Prüfungsamt übernimmt insbesondere folgende Aufgaben:

- Prüfungsanmeldungen / Zulassung
- Prüfungsrücktritte (z.B. infolge Krankheit)
- Zentrale Erfassung von Prüfungsergebnissen
- Ausstellen von Bescheinigungen, z.B. für Kindergeld
- Erstellen von Notenspiegeln für Bewerbungen or beim Fach- or Hochschulwechsel
- Erstellen von Zeugnissen und Urkunden

Die Witharbeiterinnen und Witharbeiter des Akademischen Prüfungsamtes beraten gerne in allen Prüfungsangelegenheiten. Bitte wenden Sie sich an die folgenden Adressen:

Zentrale Servicehotline:

Tel.: 0511-762-2020 *studium@uni-hannover.de*
Fax.: 0511-762-2137

Innerhalb des Prüfungsamtes gibt es zurzeit die folgende Zuständigkeit:

Bachelor- und Masterstudiengänge Mathematik

Torsten Flenner *Torsten.Flenner@zuv.uni-hannover.de*
Welfengarten 1 (Raum f 311)
30167 Hannover

Studieren im Ausland

Die Leibniz Universität bietet zahlreiche Möglichkeiten einen Teil des Studiums im Ausland zu absolvieren. Zu diesen Möglichkeiten beraten der Auslandsbeauftragte der Fakultät sowie das Hochschulbüro für Internationales.

Auslandsbeauftragter der Fakultät:

Dipl.-Ing. Axel Köhler
Appelstraße 11A (Raum A121)
30167 Hannover
sgk@maphy.uni-hannover.de
Tel.: 0511-762-5450

Mariana Stateva-Andonova
Appelstraße 11A (Raum A120)
30167 Hannover
studiensekretariat@maphy.uni-hannover.de
Tel.: 0511-762-4466

Hochschulbüro für Internationales

www.uni-hannover.de/de/universitaet/organisation/praesidialstab-und-stabsstellen/internationales/

Das Hochschulbüro für Internationales bietet Informationen und Service zu Studien- und Forschungsmöglichkeiten im Ausland. Es betreut die Austauschprogramme der Leibniz Universität Hannover und berät zu Stipendien und Fördermöglichkeiten. Im Service Center der Universität stehen Witharbeiter des Hochschulbüros für Internationales für weitergehende Fragen rund um ein Auslandsstudium zur Verfügung.

An der Fakultät wird zurzeit vor allem das Erasmus-Programm genutzt. Im Zuge des Erasmus-Programms der EU sind zahlreiche Universitäten in ganz Europa Partnerschaften zum gegenseitigen Studierendenaustausch eingegangen. Erbrachte Leistungen werden gegenseitig anerkannt. Es müssen an der Partnerhochschule keine Studiengebühren bezahlt werden.

Ombudsperson der Universität

www.zqs.uni-hannover.de/ombudsbuero.html

Das Amt der Ombudsperson zur Sicherstellung guter Studienbedingungen dient als Anlaufstelle und Ansprechpartner für Studierende, die allgemeine or individuelle Probleme, Beschwerden or Verbesserungsvorschläge bezüglich ihres Studiums und der Lehre haben. Ombudsperson ist Prof. Dr. Stephan Kabelac.

Kontakt über:

Rebecca Gora
Callinstraße 24
30167 Hannover
Postfach 172 (links neben dem Haupteingang des Hauptgebäudes)

ombudsperson@studium.uni-hannover.de
Tel.: 0511-762 - 5446

Coaching-Service und Psychologisch-Therapeutische Beratung für Studierende (ptb)

Manchmal lassen die Freude und Begeisterung über das eigene Studium im Laufe der Zeit nach. Durch die zunehmenden Anforderungen, die sowohl das Studium als auch die neue Eigenständigkeit with sich bringen, kann der Stress zu viel werden. Ohne, dass es einem bewusst ist, kommt man with der Situation nicht mehr zurecht.

With Hilfe des speziell auf Sie zugeschnittenen Beratungsservice der Psychologisch-Therapeutischen Beratung (ptb) können Sie lernen, Ihre Wege zur Lösung zu finden.

Termin vereinbaren:
Theodor-Lessing-Haus
Welfengarten 2c
30167 Hannover
www.ptb.uni-hannover.de

Tel. 0511-762 - 3799

info@ptb.uni-hannover.de

Weitere Angebote

Bibliotheken

www.tib.eu

In Hannover befindet sich die Technische Informationsbibliothek (TIB) - Leibniz-Informationszentrum Technik und Naturwissenschaften und Universitätsbibliothek direkt neben dem Hauptgebäude der Universität. Die TIB ist die Deutsche Zentrale Fachbibliothek für Technik/Ingenieurwissenschaften und deren Grundlagenwissenschaften, insbesondere Chemie, Informatik, Mathematik und Physik. Dies bedeutet, dass kein Standort in Deutschland vom Literaturbestand her für ein Studium dieser Fachgebiete besser ausgestattet ist. Außerdem gibt es Institutsbibliotheken. With der kostenlosen HOBSY-Bibliothekskarte können alle Studierenden nicht nur in TIB, sondern auch in den Standorten der Stadtbibliothek Bücher ausleihen.

Leibniz Universität IT Services (LUIS)

www.luis.uni-hannover.de

Hier werden regelmäßig Kurse zum Umgang with Programmiersprachen und Betriebssystemen angeboten (z.B. Linux, WINDOWS, C, JAVA usw.). Des Weiteren wird auch eine Reihe von Handbüchern zum Time for self-study herausgegeben (RRZN-Handbücher für staatliche Hochschulen).

Leibniz Language Centre

https://www.llc.uni-hannover.de

Das Fachsprachenzentrum bietet für Studierende kostenlose Sprachkurse an. Für Studierende der Mathematik sind gute Englischkenntnisse nicht nur für den späteren Beruf unersetzlich, sondern bereits im Studium wichtig, da viele grundlegende Lehrbücher in englischer Sprache herausgegeben werden.
Um die vorhandenen Englischkenntnisse für das Studium auszubauen, eignet sich zum Beispiel Englisch für Physik und Mathematik. Des Weiteren werden Grammatikkurse, Vorbereitungskurse für Auslandsaufenthalte und Beruf sowie Kurse für wissenschaftliche Kommunikation und Argumentation angeboten. Selbstverständlich gibt es auch Kurse für diverse andere Sprachen.

ZQS/Schlüsselkompetenzen: Bausteine für Erfolg in Studium und Beruf

Um in Studium, Praktikum und Berufsleben erfolgreich sein zu können, sind neben dem Fachwissen weitere Kompetenzen gefragt. Dazu zählen unter anderem Lernstrategien und Arbeitstechniken, ausgeprägte Kommunikations- und Präsentationsfähigkeiten, ein souveräner Umgang with Konflikten im Team or auch interkulturelle Kompetenzen.
Entscheidend für den Berufseinstieg sind darüber hinaus klare berufliche Ziele, Praxiserfahrungen, Kontakte zu Arbeitgebern sowie eine überzeugende Bewerbung.
Die ZQS/Schlüsselkompetenzen unterstützt Sie u.a. with:

- Seminare zu Schlüsselkompetenzen with Credit Pointsn

- Beratung und Workshops rund um Lern- und Arbeitstechniken sowie zum wissenschaftlichen Schreiben von Haus- und Abschlussarbeiten
- Echte Praxisprojekte in Unternehmen und Grundlagen des Projektmanagements
- Beratung und Workshops zu Bewerbung, Praktikum und Berufseinstieg
- Job Shadowing – Ein Tag im Unternehmen „schnuppern"
- Mentoring – Begleitung für den Berufseinstieg
- Firmenkontaktmesse Career Dates
- Praktika- und Stellenbörse Stellenticket

Weitere Informationen unter: www.sk.uni-hannover.de

Studieren und leben in Hannover

In diesem Abschnitt sollen einige wenige Aspekte des studentischen Lebens aufgeführt werden. Ausführlichere Informationen gibt es auf den Internetseiten von Universität und Studentenwerk Hannover.

www.uni-hannover.de *www.studentenwerk-hannover.de*

Wohnen

Wohnen

Ob eigene Wohnung, WG or Wohnheimplatz – die Suche nach vier Wänden ist für viele der erste Schritt ins Studium. Alle hilfreichen Links sind unter diesem Abschnitt gesammelt.

Eigene Wohnung/WG-Gründung Ist man auf der Suche nach einer Wohnung für sich selbst or für einer Wohnung eine WG Neugründung, so kommt man um die klassischen Seiten wie z.B. *immoscout* nicht drum herum.
Teilweise ist für einzelne (subventionierte) Wohnungen ein sogenannter *Wohnungsberechtigungsschein (B-Schein)* benötigt, davon sollte man sich nicht abschrecken lassen. Als Student ist es in der Regel kein Problem solch einen zu erhalten.
Insbesondere für WG-Neugründungen, ist es ratsam sich auch bei den sogenannten Wohnungs- or Baugenossenschaften umzuhören. Hier ist – vergleichbar with einer Kaution – bei Eintritt ein Genossenschaftsanteil zu bezahlen, den man with Austritt aus der Genossenschaft wieder zurückerhält. Aber auch auf Seiten wie WG-Gesucht finden sich vereinzelt Angebote hierfür.

Suche nach einem WG Zimmer Für die Suche nach einem WG-Zimmer ist sowohl für die Anbietenden, wie auch die Suchenden die Seite WG-gesucht, die Anlaufstelle. Gerade zum Vorlauf des Semesterbeginns gilt es hier schnell zu sein und passende WG's möglichst zeitnah nach dem Stellen der Anzeige anzuschreiben. Es ist normal hier oft keine Rückmeldungen zu erhalten, die Anbietenden werden - gerade zu Semesterbeginn - with Anfragen überflutet.
Auf den schwarzen Bretter der Uni (z.B. in den Mensen or im Lichthof im Hauptgebäude der Uni or online auf stud.ip) finden sich teilweise auch noch Angebote.
Das Schwesternhaus (siehe weiter unten) ist ebenfalls ein Anlaufpunkt für ein WG-Zimmer.

Wohnheimplatz Die Studentenwohnheime sind vom Studentenwerk gestellte, meist preiswerte, Wohnräume für Studenten. Die Gesamtwohndauer ist hier auf 3 Jahre beschränkt. Die Wohnungsvergabe läuft hier über eine Warteliste, ein Anruf über die aktuelle Angebotslage kann hier aber hilfreich sein. Hier kann es sich um Einzelappartment's, Wohnheim-WG's or sogenannte Flurgemeinschaften handeln. In Flurgemeinschaften hat man sein eigenes Zimmer, Bad und Küche werden aber vom gesamten Flur gemeinschaftlich genutzt.
Eine weitere Möglichkeit ist das *Schwesternhaus.* Das Schwesternhaus ist selbstverwaltet. Die studentischen Mieter bestreiten in Eigenregie sämtliche Maßnahmen zur Wartung, Pflege und Mornisierung des Hauses. Hier trägt jeder etwas bei: die Wasserschwestern kümmern sich um Wasserleitungen, die Renoschwestern um bauliche Maßnahmen, die Gartenschwestern um die

Pflege des Gartens, und so weiter. Das Schwesternhaus ist offen für alle Geschlechter und Studienrichtungen.

Vorübergehende Unterkunft/Notunterkunft Hat es zum Semesterstart nicht geklappt with einer Wohnung or man hat extrem verspätet z.B. im Losverfahren erst den Studienplatz bekommen so gibt es noch Überbrückungsmöglichkeiten für die ersten Monate des Studiums.
Zu allererst Sei hier nochmal die WG-Foren genannt, hier werden auch öfters (spontan) Zwischenmietende gesucht. Das Schwesternhaus bietet ebenfalls Notunterkünfte an. Eine andere Möglichkeit bietet die Jugendherberge, diese bietet für Studenten zum Semesterstart besondere Wochen und Monatstarife an. Der AStA bietet eine Schlafplatzbörse an, hier können sich Anbietende sowie Suchende melden, die einen Schlafplatz anbieten or suchen.

Warnhinweis Achtet bitte bei der Suche nach Wohnungen -insbesondere über Foren or Angebotsseiten - auf die Seriosität der Angebote. Teilweise sind dort Betrüger unterwegs. Überweist nie Geld ohne die Wohnung gesehen und einen Vertrag unterschrieben zu haben.

Hilfreiche Links
https://www.wg-gesucht.de/ (WG-Zimmer)
https://schwesternhaus.de/ (WG-Zimmer, Wohnheim, Notunterkunft)
https://www.studentenwerk-hannover.de/wohnen/uebersicht (WG-Zimmer, Wohnung, Wohnheim)
https://www.immobilienscout24.de/ (Wohnung, WG-Neugründung)
https://baugenossenschaft.info/baugenossenschaften-niedersachsen/wohnungsgenossenschaften-hannover/ (Übersicht Wohnungs-/Baugenossenschaften Hannover)
https://www.jugendherberge.de/lvb-hannover/long-stay-miete-fuer-studierende/ (Notunterkunft)
https://www.asta-hannover.de/service/soziales/schlafplatzborse/ (Notunterkunft)

Essen und Trinken

In der Hauptmensa kann man aus einer Auswahl von bis zu 10 Gerichten wählen. Die Hauptmensa zählte in diversen Untersuchungen in den Bereichen Qualität, Preis und Auswahl immer wieder zu den besten Mensen Deutschlands. Des Weiteren gibt es für den kleinen Hunger acht Cafeterien an den verschiedenen Universitätsstandorten. Die Cafeteria "Sprengelstube" im Hauptgebäude bietet sich auch zum Aufenthalt zwischen den Lectureen an.
www.studentenwerk-hannover.de/essen.html

Verkehr

With dem Semesterticket können Studierende die öffentlichen Verkehrswithtel in der Region Hannover und fast alle Nahverkehrszüge in Niedersachsen nutzen. Da der größte Teil der Radwege in einem guten Zustand ist, kommen viele Studierende with dem Fahrrad zur Universität. Im Semesterbeitrag ist ein geringer Beitrag enthalten, der für die Fahrradwerkstätten verwendet wird, in denen man Fahrräder kostenlos reparieren lassen kann. Nähere Informationen zum Semesterticket und Fahrradwerkstätten sind beim AStA zu bekommen.

www.asta-hannover.de

Hochschulsport

Der Hochschulsport ist ein Angebot an alle Studierenden, gemeinsam Sport zu treiben, sich zu bewegen und vom Uni-Stress zu erholen. Die verschiedenen Kurse von Aikido über Basketball und Leichtathletik bis Yoga sind überwiegend kostenlos für Studierende or deutlich billiger als in den meisten Sportvereinen. Zu Beginn jedes Semesters wird das Sportprogramm herausgegeben, aus dem man Kurse auswählen kann. Auch in der Lecturesfreien Zeit werden Kurse angeboten. Das Sportprogramm ist beim Sportzentrum als Broschüre, aber auch im Internet erhältlich.
www.hochschulsport-hannover.de

Finanzielles und Soziales

In jedem Semester müssen alle Studierenden einen Semesterbeitrag bezahlen. Dieser wird vor allem für das Semesterticket, den "Verwaltungskostenbeitrag" und das Studentenwerk bezahlt
Sofern das Studium länger als die Regelstudienzeit plus weitere vier Semester dauert, sind jedes Semester sogenannte Langzeitstudiengebühren zu zahlen, wobei es z.T. Ausnahmeregelungen gibt. Der Betrag erhöht sich with der Länge des Studiums. Hierüber informiert das Immatrikulationsamt.
Beratung zum BAFöG bietet die BAFöG-Abteilung des Studentenwerks Hannover und die BAFöG- und Sozialberatung im AStA.
www.studentenwerk-hannover.de/bafoeg-und-co.html
www.asta-hannover.de

HiWi-Jobs und Arbeitsmöglichkeiten

Die beste Möglichkeit, nicht nur Geld zu verdienen, sondern auch Erfahrungen für den späteren Beruf zu gewinnen und StudienContente zu wiederholen, ist als studentische Hilfskraft im Bereich der Universität zu arbeiten. Hier ist Witharbeit in der Forschung und Verwaltung der Institute or im Bereich der Lehre möglich. Bei Interesse empfiehlt es sich die Dozenten und wissenschaftlichen Witharbeiter direkt anzusprechen. Sie stehen gern beratend zur Verfügung.
Daneben bietet Hannover als bedeutende Industrie- und Handelsstadt auch in Firmen, Verwaltung und Dienstleistung sowie bei den Messen (z.B. Hannover Industriemesse) diverse Möglichkeiten für Studierende, Geld zu verdienen.

Anhang Links und Lagepläne

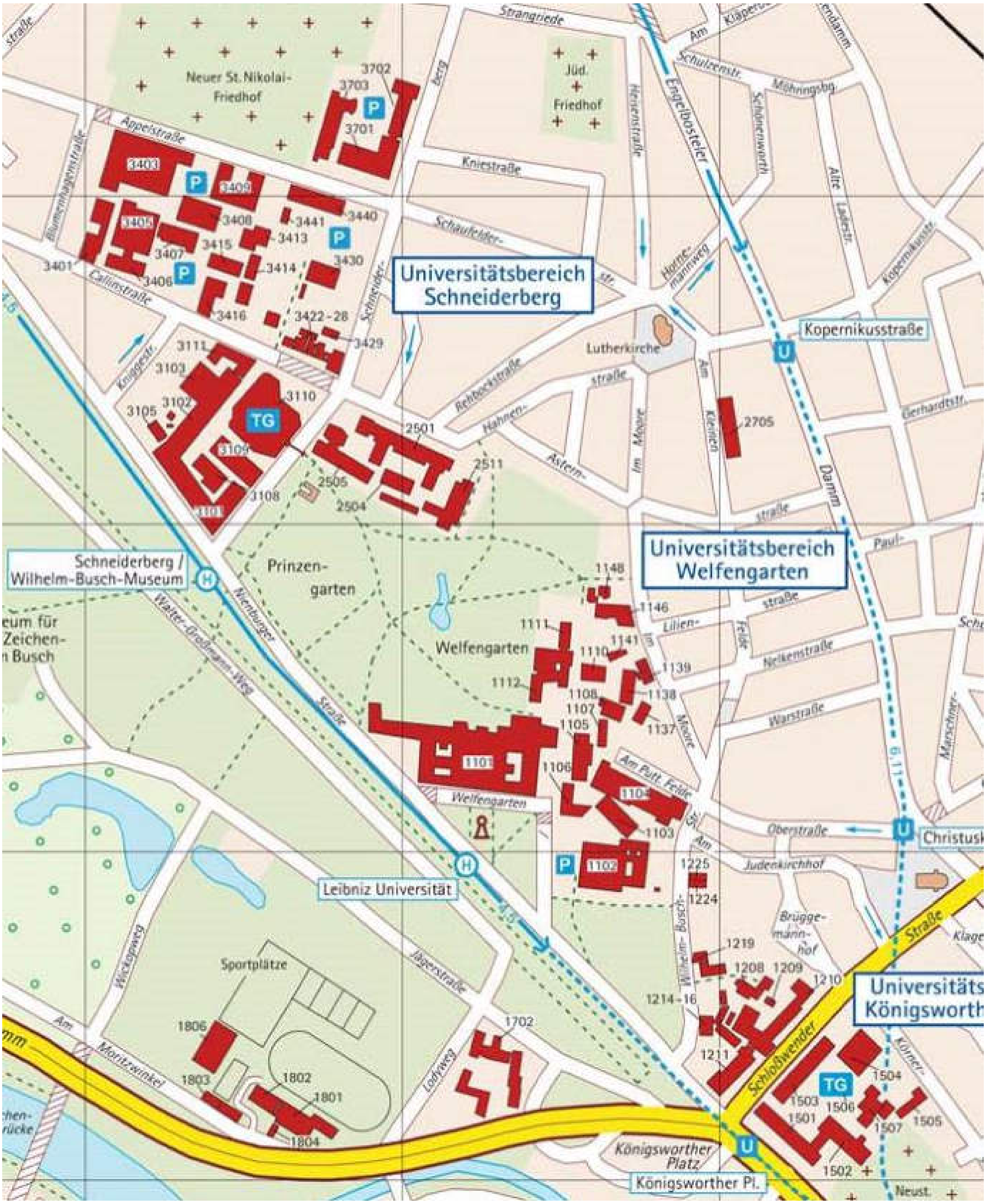
Links

Zentraler Bereich Studium der Fakultät-Homepage:
www.maphy.uni-hannover.de/studium

Prüfungsordnungen Bachelor:
Bachelor of Science in Mathematik:
www.uni-hannover.de/de/studium/im-studium/pruefungsinfos-fachberatung/mathematik-bsc/ordnungen/

Prüfungsordnungen Master:
Master of Science in Mathematik:
www.uni-hannover.de/de/studium/im-studium/pruefungsinfos-fachberatung/mathematik-msc/ordnungen/

Lagepläne



Neuer St. Nikolai-Friedhof
Jüd. Friedhof
Strangriede
Appelstraße
Callinstraße
Kniestraße
Schaufelder-str.
Schneiderberg
Universitätsbereich Schneiderberg
Lutherkirche
Kopernikusstraße
Universitätsbereich Welfengarten
Schneiderberg / Wilhelm-Busch-Museum
Prinzengarten
Welfengarten
Nienburger Straße
Walter-Gropmann-Weg
Leibniz Universität
Sportplätze
Jägerstraße
Königsworther Platz
Königsworther Pl.
Schloßwender Straße
Oberstraße
Judenkirchhof
Nelkenstraße
Warstraße
Engelbosteler Damm
Universitäts Königsworth
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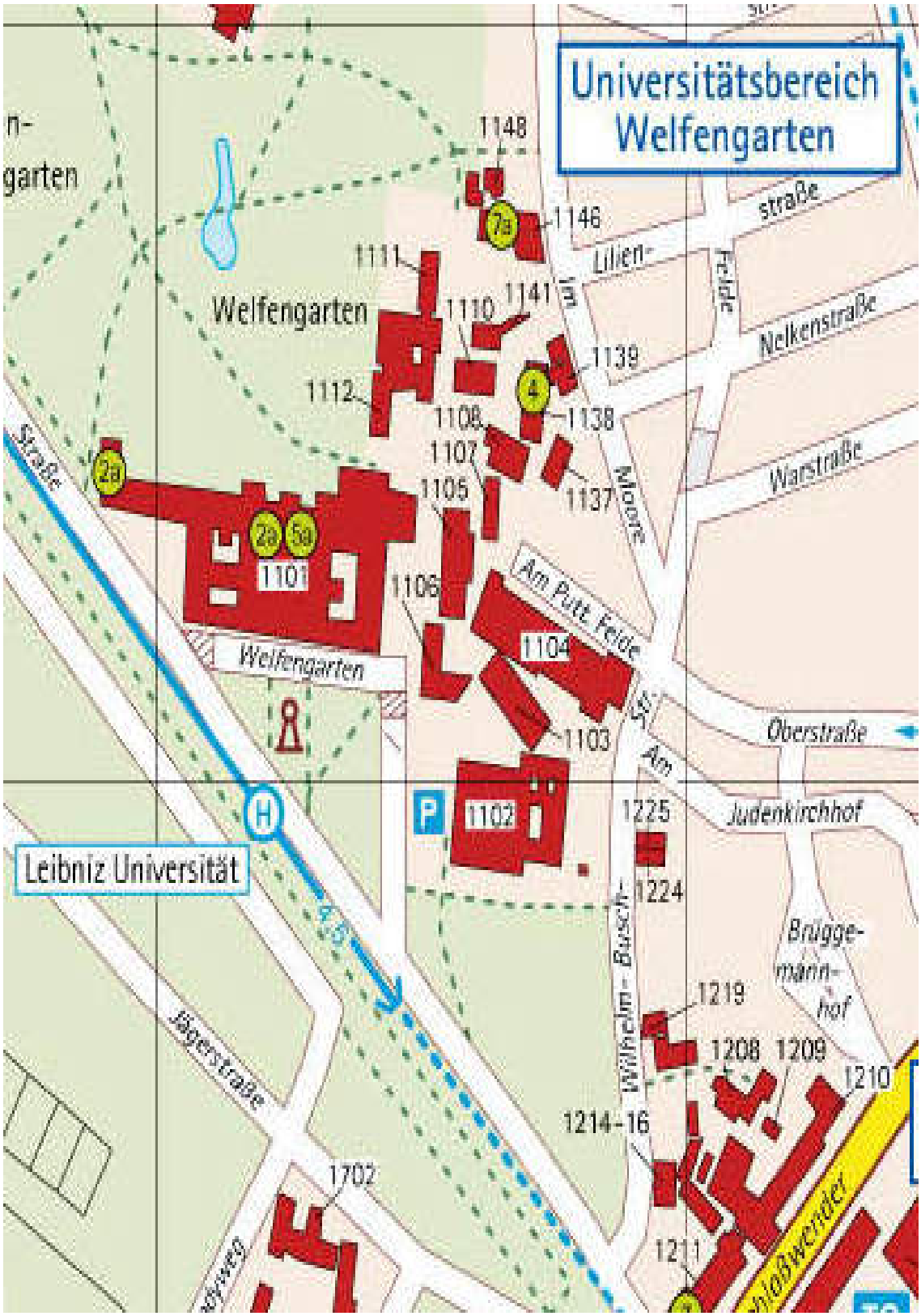
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Nelkenstraße
Warstraße
Moore
Am Pütt. Felde
Oberstraße
Judenkirchhof
Wilhelm-Busch-
Brugge-
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