DIRECTORY OF MODULES OFFERED IN ENGLISH LANGUAGE

COURSES OFFERED IN ENGLISH AT THE UNIVERSITY OF GÖTTINGEN
ACADEMIC YEAR 2017/2018

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

A very warm welcome!

The University of Göttingen features an outstanding study environment for both exchange and full-degree students. All courses of study benefit from an excellent research-oriented environment formed by a broad network including five Max Planck Institutes, the German Primate Centre, the German Aerospace Centre and the Academy of Science and Humanities: the Göttingen Campus. An increasing number of lectures and courses are taught in the English language attracting more and more international students. This catalogue provides an impression of what is available.

This catalogue of courses taught in English varies from faculty to faculty and the courses available to you depend on whether you are an exchange student coming to Göttingen for a semester or an academic year, or whether you are a full degree student coming to Göttingen to complete an entire degree programme. You may take most courses in the programme you are enrolled in, however in a few cases restrictions may apply. Selecting courses from other subjects or other departments might require negotiations. If you have any questions, please contact the study advisor in charge of your subject.

Prior to their arrival in Göttingen exchange students have to set up a learning agreement. In some cases restrictions will apply, e.g. signing up for certain laboratory courses may not be possible. Generally exchange students are required to take at least half of the lectures and courses within their chosen subject.

Full degree students must first apply for a study place. Links to websites with application guidelines and deadlines are provided by some subjects/faculties. If not stated otherwise please visit:

http://www.uni-goettingen.de/en/3811.html

In any case, you are very welcome to browse through this catalogue to find/check out courses that suit your interests! For the complete course catalogue of the University of Göttingen see:

https://univz.uni-goettingen.de/qisserver/

We look forward to welcoming you in Göttingen!

Index by areas of study

I. Faculty of Agricultural Sciences

The Faculty of Agricultural Sciences offers two full master programs in English language:

- **Sustainable International Agriculture**: *http://www.uni-goettingen.de/en/96913.html*
- **Crop Protection**: *http://www.uni-goettingen.de/de/135654.html*

Since the Faculty offers almost no Bachelor courses in English language, the exchange students are invited to take part in the master courses independent of their level at the home university.

II. Faculty of Biology and Psychology

1. Biology

a. Bachelor programmes

The courses/modules available varies depending whether you are degree or exchange student.

All B.Sc. programmes are taught in German.

aa. Degree students

German knowledge of level DSH2 is required.

Information and contact details about the different study programmes can be found here:

http://www.uni-goettingen.de/de/bachelor--2-fach-bachelor-biologie/122050.html

bb. Exchange students

German knowledge of level B2 is recommended.

Information and contact details about application procedure and courses available for exchange bachelor students can be found here:

http://biologie.uni-goettingen.de/incoming_en

For courses in German language German knowledge of CEFR level B2 is recommended.

Course admission restrictions may occur depending on your previous knowledge in biology and other natural sciences.

b. Master programmes

The courses/modules available varies depending whether you are degree or exchange student.

All M.Sc. programmes are taught in English.

aa. Degree students

Proof of proficiency in English (level C1 according to *Common European Framework* of Reference for Languages, CEFR) and German (CEFR level B1) is mandatory at the time point of application.

i. M.Sc. Microbiology and Biochemistry

Information and contact details about application procedure and study programme details can be found here:

http://www.uni-goettingen.de/en/35341.html

ii. M.Sc. Development, Neural and Behavioral Biology

Information and contact details about application procedure and study programme details can be found here:

http://www.uni-goettingen.de/en/38560.html

iii. M.Sc. Biodiversity, Ecology and Evolution

Information and contact details about application procedure and study programme details can be found here:

http://www.uni-goettingen.de/en/123968.html

bb. Exchange students

You can participate in the courses listed below from the different master programmes, however it requires

- previous knowledge in the field of study and
- a language proof (CEFR level C1) at the time point of application.

Information and contact details about application procedure and courses available for exchange master students can be found here:

http://biologie.uni-goettingen.de/incoming_en

2. Psychology

No courses available, as all study programmes in Psychology are taught in German.

III. Faculty of Chemistry

In our Master´s programme we offer a various range of lectures in English. Please, feel free to contact us at the Dean´s office (*dekanat@chemie.uni-goettingen.de*). We are pleased to inform you about the lectures held in English in the semester you wish to come to Göttingen.

It is always possible to participate in the practical courses in our research groups (Modules *M.Che.1116, M.Che.1117, M.Che.1221, M.Che.1222, M.Che.1321, M.Che.1322*). All group leaders welcome English speaking guest students, though formally the modules are offered in German.

IV. Faculty of Forest Sciences and Forest Ecology

The Faculty of Forest Sciences and Forest Ecology offers two full degree programs in English language.

- **Molecular Ecosystem Sciences**: *http://www.uni-goettingen.de/en/221690.html*
- **Forest Sciences and Forest Ecology – Tropical and International Forestry**: *http://www.uni-goettingen.de/en/introduction/74615.html*

Since the Faculty offers no Bachelor courses directly related to the field of forest sciences and forest ecology exchange students are invited to take part in the Master courses independent of their level at the home university.

1. Bachelor: Molecular Ecosystem Sciences

Students who are planning to participate in practical, laboratory or computer courses (see course description) have to contact the named coordinator first.

2. Master: Forest Sciences and Forest Ecology - Tropical and International Forestry

V. Faculty of Geoscience and Geography

VI. Faculty of Mathematics and Computer Science

1. Mathematics

a. Bachelor modules

b. Master modules

2. Computer Science

VII. Faculty of Physics

1. Bachelor modules

2. Master modules

3. Key competency modules

XI. Faculty of Social Sciences

http://www.uni-goettingen.de/en/faculty-of-social-sciences/20495.html

XII. Faculty of Theology

XIII. Faculty of Economic Sciences

The Faculty of Economic Sciences offers an excellent international study environment for students coming from outside of Germany including both those who plan to complete their entire degree in Göttingen, as well as those who plan to visit for a semester abroad.

Our faculty offers many English-language courses (*http://www.uni-goettingen.de/en/winter-semester-20142015/474472.html*) for short-term visitors and exchange students for both undergraduate and graduate students.

Every semester we offer at least 30 ECTS credits worth of courses in business administration and economics for BA students (11 courses offered in the 2014/15 winter semester). There are also many courses in English for MA students in both business administration and economics. In the 2014/15 winter semester, the faculty offered 29 courses for economic students and 14 courses business administration students.

For students interested in completing their entire degree in Göttingen, the faculty offers an entirely English-language MA degree indevelopment economics (*http://www.uni-goettingen.de/de/203661.html*). Our programme is the only university-level master’s programme in development economics in Germany, and is based on research groups from various areas including agricultural economics and rural development, and economics. The programme duration is four semesters, and can even be coupled with a double degree programme with Stellenbosch University in South Africa.

In addition to the course offerings, our faculty offers a vibrant and internationally-oriented research community with research projects abroad, including visiting faculty and doctoral researchers from across the globe.

For further information about the Faculty, please visit:
http://www.uni-goettingen.de/en/international-students--researchers/427247.html
We look forward to your visit.

1. Bachelor modules

2. Master modules

Georg-August-Universität Göttingen **Module B.MES-SK.105: Laboratory techniques**	6 C 4 WLH
Learning outcome, core skills: Students will train in small groups to work in a laboratory. They will be introduced into modern basic and sophisticated methods in the fields of chemistry, biochemistry, microbiology and molecular biology to rules assuring personal and environmental safety and good scientific practice. Students acquire knowledge in experimental planning, technical performance, data interpretation and documentation of practical scientific research.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Organic trace analysis (Seminar, laboratory course, exercises)	2 WLH
2. Inorganic analysis (Seminar, laboratory course, exercises)	1 WLH
3. Microbiology and molecular biology (Laboratory course)	1 WLH
Examination: Protocol (30 pages max.) **Examination prerequisites:** Regular attendance and participation	6 C
Examination requirements: Personal and environmental safety, handling and preparation of samples, calibration and use of standards, chromatographic methods, design, performance and documentation of chemical, microbial, and molecular experiments, assessment of results, team work to resolve experimental problems. Handling of radioactive substances, radiation safety, analytics of radioactive isotopes, contaminations with stable and radioactive isotopes .	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES-SK.110: The science-policy interface: society and research structures**	6 C 4 WLH

Learning outcome, core skills: Policy of Ecosystems: Knowledge about both: on the one hand the relation between ecosystem sciences and politics and on the other hand about the structure and processes of policy-making. Skills in political consulting and debating. The Research Community: Structure and Organization The scientific community depends on private and public research organizations and funding mechanisms. Students will understand the structure and organization of main institutions conducting or financing research and teaching (universities and large research institutions) in Germany and elsewhere.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Policy of ecosystems (Seminar)	2 WLH
2. The research community: structure and organization (Lecture, seminar)	2 WLH
Examination: 2 Oral presentations (approx. 10 minutes) with written outline (10 pages max.)	6 C

Examination requirements: Current theories of science-policy interface and scientific conditions for knowledge transfer, conditions for application of ecosystem knowledge in society, basics of public policy analysis, research infrastructures, comparison between different research structures. Skills: understanding of the relationship between ecosystem research and actual utilization in society, understanding of the role of different actors in science, planning a research career.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Maximilian Krott
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES-SK.115: Scientific methods and project design**	6 C 4 WLH

Learning outcome, core skills: Understanding, application and interpretation of basic terms of descriptive and confirmative statistics, such as important discrete and continuous distributions, least squares, confidence intervals, testing statistical hypotheses, error propagation and basic experimental designs. Understanding of advanced statistical methods such as two-way ANOVA and multiple regressions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Research methods (Lecture)	3 WLH
2. Research methods (Exercises)	1 WLH
Examination: Written examination (90 minutes)	6 C

Examination requirements: Detailed knowledge of methods for statistical analysis (t-tests, ANOVA, regression, nonparametric methods), descriptive statistics and probability distributions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Kurth
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.101: Molecular plant and stress physiology**	6 C 4 WLH

Learning outcome, core skills: In this course the students will learn how a plant functions at the cell, tissue and whole-plant level. The contents of the lectures encompass basic cell biology and plant physiology (nutrient uptake, and transport process, photosynthesis, respiration, plant hormones, development and stress adaptation). In the practical courses students will be trained at modern microscopes, will lean the basics of tissue culture, and will obtain practical expertise with the use of ecophysiological methods such as measurements of photosynthesis, fluorescence, water potentials etc.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Molecular plant physiology (Lecture)	2 WLH
2. Cell biology, tissue culture and stress responses (Practical course)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Cell compartments and organelles, their structure and function, membrane transport, molecular principles of photosynthesis and respiration, molecular functioning of plant hormones in plant development and stress adaptation, tree biotechnology. Skills: solid theoretical foundation in plant physiology and practical skills in tree regeneration and working under sterile conditions.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in biology
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen Module B.MES.102: Chemical ecology	6 C 4 WLH
Learning outcome, core skills: Students will learn to analyze the molecular basis of plant-insect interactions from the plant and from the insect point of view, based on plant volatiles associated to plant stress correlating with defence status and nutritional value of the plant. They learn how information gained by insect antennae is examined to understand the translation of this information into insect behaviour. Students will learn to assess how sensor-systems on the basis of insect olfaction can be utilized and how chemo-ecological findings can be extended into landscape by an integrative examination of biotic interactions from the molecular to the stand level. This will be the basis for understanding the role of semiochemical diversity in adaptation toward global change and for ecosystem functions and services.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Chemical ecology (Lecture)** **2. Exercises in chemical ecology (Laboratory course, seminar)**	 1 WLH 3 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Biosynthesis of semiochemicals, signaling pathways, perception of semiochemicals, transduction pathways, physiological action and behavioural activity of semiochemicals, syn- and demecological aspects.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.103: Ecological genetics**	6 C 4 WLH
Learning outcome, core skills: Understanding of the importance of intraspecific (genetic) variation for ecosystem processes and functions, in particular • knowledge of modern methods to assess genetic diversity in diverse groups of organisms • understanding of the role of the evolutionary factors to shape genetic diversity with emphasis on selection • understanding of evolutionary processes including adaptation under natural conditions and in managed ecosystems • understanding of the impact of global change on genetic resources	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Ecological genetics** (Lecture)	2 WLH
2. Assessment of genetic variation (Laboratory course, workshops)	2 WLH
Examination: Oral examination (approx. 20 minutes)	
Examination requirements: Use of modern methods to assess genetic variation in diverse groups of organisms, evolutionary factors and how they shape genetic diversity, the role of adaptation under natural or managed conditions, impact of global change.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.104: Biotic and abiotic interactions**	6 C 4 WLH

Learning outcome, core skills: Interactions between biotic and abiotic components of ecosystems are largely responsible for ecosystem properties and functions. Abiotic interactions will be studied in a submodule focused on the biochemistry of soils; biotic interactions are introduced with a focus on pathogens. Students will be trained to analyze these important ecological interactions at different scales. Significance of soil biochemistry for ecosystem processes will be analyzed based on basic soil properties and chemical principles. Transformations and interactions between solid, liquid, gaseous and living phases in soil will give background for understanding of soils as the main part of terrestrial ecosystems and application of biochemical knowledge from molecular to pedon and field scales. Biotic interactions will be studied at different levels taking into consideration their molecular basis such as genes and their products and with different organisms, plants and/or animals including wildlife.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Soil biochemistry (Lecture, seminar)	2 WLH
2. Biotic interactions in ecology (Lecture, seminar)	2 WLH
Examination: Written exam (90 minutes)	6 C

Examination requirements: Biochemical processes in soils, weathering and soil formation, biotic drivers, factors of soil formation, soil organisms and decomposition processes, soil organic matter and interactions with clay minerals, molecular basis of biotic interactions, genes and their products, interactions among different organisms.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yakov Kuzyakov
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.106: Microbiology and molecular biology**	6 C 4 WLH

Learning outcome, core skills: Students will be introduced to molecular, biochemical and physiological aspects in microbiology and molecular biology which is important to Ecosystem Sciences. The acquired knowledge allows the students to address questions and problems in Ecology and Systems Biology on molecular levels and understand the background of modern molecular methods that can be applied to solve such topics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Microbiology and biotechnology (Lecture)	2 WLH
2. Molecular biology (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Basic knowledge on genetics, physiology, and ecology of microorganisms (bacteria and fungi), applications of microorganism in biotechnology generally and with specific focus on ecological tasks, structure and functions of DNA, RNA, proteins and exemplified metabolites, basic concepts and techniques in molecular biology, recombinant DNA technology, DNA transfer techniques, handling of GMOs.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ursula Kües
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen Module B.MES.107: Ecological modelling	6 C 4 WLH
Learning outcome, core skills: Comprehensive knowledge of ecological models, theories and concepts. Development of interdisciplinary analytical thinking. Critical analysis and evaluation of the chances and limitations of different modelling approaches.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Ecological modelling (Lecture)** *Contents*: Theoretical basics as well as classical and modern models of terrestrial ecology with special consideration of models in microbial ecology.	 2 WLH
2. Ecological modelling (Tutorial) *Contents*: Application and analysis of classic and modern ecological models and concepts .	2 WLH
Examination: Written exam (90 minutes)	6 C
Examination requirements: Comprehensive knowledge of ecological models, theories and concepts. Interdisciplinary analytical thinking skills. Ability to critically analyze and evaluate the chances and limitations of different modelling approaches.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Kerstin Wiegand
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.108: Computer science and mathematics**	6 C 4 WLH
Learning outcome, core skills: Understanding of basic notions and methods of computer science and mathematics, including: representation of information, databases, the World Wide Web, foundations of programming, simulation, visualization; notations from logic and set theory, relations, graphs, functions, differentiation, extreme values, integration; vectors, linear transformations, matrices, eigenvalues; scale levels of variables, measures of location, dispersion and correlation, linear regression, probability, sampling, confidence intervals, fundamentals about statistical testing.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Computer science and mathematics (Lecture)** **2. Computer science and mathematics (Exercise)**	 3 WLH 1 WLH
Examination: Written exam (90 minutes)	6 C
Examination requirements: Understanding of basic notions and methods of computer science and mathematics, including: databases, WWW, foundations of programming, simulation, visualization; graphs, functions, differentiation, extreme values, integration; vectors, linear algebra; descriptive statistics, linear regression, probability, sampling, simple tests.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Kurth
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.109: Plant ecology and diversity**	6 C 4 WLH
Learning outcome, core skills: Students are familiar with global to regional scale patterns of plant diversity, the distribution of major climatic and vegetation zones (ecozones, biomes), as well as their predominant land uses and anthropogenic impacts. Students are familiar with basic aut- and synecological concepts in plant and vegetation ecology from the level of the individual plant to plant communities. They have learned to distinguish different major plant communities in Central Europe and are familiar with their specific abiotic site conditions, and their conservation significance. Students are able to apply ecological field methods and to perform basic analyses of diversity and community structure.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Plant ecology and diversity (Lecture)**	 2 WLH
2. Plant ecology and diversity (Field studies)	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Distribution and determinants of ecozones and biomes, local to global scale patterns of plant diversity, alpha-beta-gamma diversity, aut-and synecological concepts, plant communities and their relations with abiotic site conditions, basic knowledge about field and analysis methods.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Holger Kreft
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.111: Terrestrial biogeochemistry**	6 C 4 WLH
Learning outcome, core skills: At the end of this course students should understand the major biogeochemical processes at the interface of biosphere, lithosphere hydrosphere and atmosphere. Students will be able to detect where measurements of biogeochemical processes are useful using a system based approach. They will have gained practical experience in relevant measurements of biogeochemical processes in terrestrial ecosystems.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Terrestrial biogeochemistry (Lecture)	2 WLH
2. Biogeochemical processes (Laboratory course)	2 WLH
Examination: Written examination (120 minutes) and term paper (10 pages max.)	6 C
Examination requirements: Cycles in biogeochemistry, element ratios, carbon cycle of terrestrial ecosystems, biogeochemical cycling on land, nitrogen cycle of terrestrial ecosystems, soil development, mass balances at different scales, redox reaction in natural environments, biogeochemistry of wetlands, measurements of biogeochemical processes.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.112: Environmentally friendly production of wood**	6 C 4 WLH
Learning outcome, core skills: Environmentally friendly use of timber, of wood for energy and wood products. Basics and practice of wood protection and degradation by fungi. Knowledge of technological relevant wood properties of important commercial timbers. Modification technology for long-living major forest products (lumber, veneer, plywood, wood-based composites) and their significance for forest utilization.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Wood biology (Lecture, exercises, laboratory visits, excursion) *Contents*: Classroom lectures with practical exercises, visits in labs and short presentations of the students, one excursion to a wood processing company.	2 WLH
2. Wood-based-composites (Lecture, exercises, laboratory visits, excursion) *Contents*: Classroom lectures with practical exercises, visits in labs and short presentations of the students, one excursion to a wood processing company.	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Anatomy, wood physics, wood chemistry, wood properties, wood-based composites, wood-plastic composites, wood modification, wood protection.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Holger Militz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.113: Methods in systems biology**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
"Omics" techniques are the backbone of modern systems biology. This course comprises lectures and practicals in genomics, proteomics, transcriptomics and statistical computing. The students will learn the theory of these applications, and the functioning of the required hard- and software. The students will obtain practical training in selected methods. This involves lab work as well as computer applications. The learning outcome will be that the students are to apply "omics" methods to questions in ecology and systems biology.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Genomics (Lecture, practicals)	1 WLH
2. Statistical computing and Transcriptomics (Lecture, practicals)	2 WLH
3. Proteomics (Lecture, practicals)	1 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements:	
Detailed knowledge and understanding of methods to generate and analyse experiments involving approaches of modern systems biology. This includes a detailed understanding of basic statistical concepts to analyse “omics“ data sets as well as skills in laboratory analyses and application of software for proteomic and transcriptomic data analysis.. Skills: knowledge how to analyse plant tissues by application of molecular and statistical methods.	

Admission requirements:	**Recommended previous knowledge:**
Admission requirements: Successful examination in a minimum of 2 of the following courses: B.MES.101: Molecular plant and stress physiology, B.MES.103: Ecological genetics, B.MES.106: Microbiology and molecular biology, B.MES.108: Computer science and mathematics.	none
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.114: Biodiversity of pro- and eukaryotic soil microbial communities**	6 C 4 WLH

Learning outcome, core skills: Biodiversity, phylogenetics, morphology and functions of soil microbial communities consisting of prokaryots (archea, bacteria) and eukaryots (algae and fungi); diversity of prokaryotic microbial metabolism and environmental functions. Knowledge of prokaryotic microorganisms and algae relevant for environmental functions, ability to identify these organisms and to analyse them with molecular methods; ability to identify major lineages of cyanobacteria and eukaryotic algae from cultures by microscopy.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Biodiversity of pro- and eukaryotic soil microbial communities (Lecture)	2 WLH
2. Biodiversity of pro- and eukaryotic soil microbial communities (Laboratory course)	2 WLH
Examination: Protocol (10 pages max.)	6 C

Examination requirements: Students prove their ability to perform specific microbiological molecular techniques independently and their ability to record, interpret and present their experimental results in written form.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Rolf Daniel
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.116: Conservation and ecosystem management**	6 C 4 WLH

Learning outcome, core skills: The course imparts knowledge about the sustainable management of forest ecosystems and about nature conservation. Based on some fundamentals of forest ecology such as the impact of competitive interactions between trees, options of stand management are presented. Mixed stands and their management are of special importance. The course will provide information on how to analyze forest stands and how to derive appropriate silvicultural treatments in order to achieve the goals set by a given forest owner. The nature conservation part will introduce priority goals of conservation biology, the major threats to natural ecosystems and how they can be managed.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Forest ecosystem management (Lecture)	2 WLH
2. Nature conservation (Lecture)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Competition in plant communities, plant – environment interactions, mixed stands, principles of stand management, silvicultural systems, human land-use, climate change, biodiversity, ecosystem functioning.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christian Ammer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.117: Atmosphere-ecosystem interactions**	6 C 4 WLH

Learning outcome, core skills: In this course students will gain insights in the main atmospheric characteristics and how they influence ecosystem processes and fluxes between ecosystem compounds (e.g. air, plants, soil). They will also learn how ecosystems feed back to the atmosphere at local and global scale. This will form the basis for understanding the impact of climate change on ecosystem functions and services. The lecture course will give an overview on atmospheric variables such as radiation, humidity, temperature, and wind and their interactions with terrestrial ecosystems. In the seminar/exercise class, the understanding will be deepened by quantitative exercises. The students will be trained in quantitative and qualitative scientific methods to describe climate-dependent physical, chemical and biological processes in terrestrial ecosystems enabling them to understand and evaluate the current discussion on climate change and its impact on terrestrial ecosystems.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Atmosphere-ecosystem interactions (Lecture)	2 WLH
2. Atmosphere-ecosystem interactions (Seminar, exercise)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Qualitative and quantitative description of radiation, humidity, temperature, wind, their interactions with terrestrial ecosystems, carbon and water cycle, atmospheric chemistry, climate change, climate modelling.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Alexander Knohl
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen Module B.MES.118: Resource assessment in ecosystems	6 C 4 WLH

Learning outcome, core skills:	Workload:
The students will be trained • to analyse issues and problems of ecological monitoring, with a focus on terrestrial ecosystems, • to plan their own monitoring studies on statistically sound grounds balancing scientific-technical ojectives and economic feasibility, • to critically assess and understand monitoring studies carried out by other. These learning outcomes imply acquiring / enchancing knowledge and skills in the following fields: • design-based statistical sampling, including estimation design, • empirical statistical models, • characteristics of a seriers of sampling designs and plot designs, • the systematic planning process in monitoring studies.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Resource assessment in ecosystems (Lecture) *Contents*: The lectures comprise the theoretical foundations of monitoring and also the discussion based analysis of cases.	2 WLH
2. Resource assessment in ecosystems (Laboratory course) *Contents*: The field labs are practical exercises in field data collection techniques and measurement devices, the in-house labs are on data analysis and estimation.	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements:	
Basics of descriptive and inferential statistics (mean, variance, standard error, confidence interval, bias, precision, random selection), relevant basic sampling design options (simple random, stratified random, systematic, cluster sampling), relevant response designs options (fixed area plots, variable plots, distance techniques, point sampling, line sampling). Statistical estimation. Planning criteria for assessments.	

Admission requirements:	Recommended previous knowledge:
B.MES-SK.115, B.MES.108	none
Language: English	**Person responsible for module:** Prof. Dr. Christoph Kleinn
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5

Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.119: Isotopes in ecosystem sciences**	6 C 4 WLH
Learning outcome, core skills: The course provides a very broad background for isotope applications in ecosystem compartments including soils, plants, atmosphere, and microorganisms. Overview of various tracer methods and isotope applications will be presented. The specifics of stable and radioactive isotopes for investigations of ecosystem processes from submolecular to global scale will give deep background for future isotope applications in Bachelor, Master and PhD theses.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Stable isotopes (Lecture, seminar with exercises)**	 2 WLH
2. Radioactive isotopes and labeling techniques (Lecture, seminar)	2 WLH
Examination: Written exam (90 minutes)	6 C
Examination requirements: Knowledge of specified teaching content, achievement of defined goals and proof of target competence.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yakov Kuzyakov
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen Module B.MES.121: Global change	6 C 4 WLH
Learning outcome, core skills: At the end of this course the students are expected to • have insight in the major components of the earth system and how they are connected, • understand how environmental processes and biogeochemical cycles are regulated by biosphere-hydrosphere-atmosphere feedbacks and how they are affected by global chance through natural and anthropogenic processes, • are able to understand and evaluate simple biogeochemical models.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Global change (Lecture)	2 WLH
2. Global change (Modelling exercises, seminar)	2 WLH
Examination: Presentation (approx. 30 minutes, 50%) and written report (10 pages max., 50%) **Examination prerequisites:** Successful completion of exercises and seminar	6 C
Examination requirements: Successful completion of assignments. After every lab students are given a mandatory homework assignment (though not graded).	

Admission requirements: none	**Recommended previous knowledge:** B.MES.111, B.MES.117
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.122: Molecular soil ecology**	6 C 4 WLH
Learning outcome, core skills: This lecture and laboratory course aims to integrate the basic knowledge on soil microbiology in ecological studies. The course is focused on the importance of active microorganisms and their diversity of species/genetic lineages as biogeochemical driver of soil processes linking microbial growth, enzymes kinetics and the stoichiometry with the modern molecular and isotopic approaches. Experiments will demonstrate how the hotspots of microbial activity (rhizosphere, detritusphere, biopores) can be revealed and visualized in situ in soil. • Goup 1: The microbial activity state is characterized by the values of eco-physiological indicators based on respiration, molecular biomarkers and viable cell compartments (ATP, PLFA, RNA). The Laboratory training links visualization of plant-microbial interactions by novel zymography approach (based on fluorogenic substrates) with enzyme kinetics and microbial growth parameters determined in the rhizosphere hotspots under impact of environmental stressors. • Group 2: Students will become familiar with molecular technologies used for analyzing the structure and function of decomposer systems, such as quantitative real time PCR, tagging of organisms by fluorescent markers compound specific stable isotope lipid analysis and molecular gut content analysis.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Molecular soil ecology (Lecture and Seminar)	2 WLH
2. Molecular soil ecology (Laboratory course and Seminar)	2 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (10 pages max.)	6 C
Examination requirements: Knowledge on: • Plant-microbial and microbial interactions in soil • Functional diversity and genetic diversity of soil microbial communities • Techniques to analyze soil-micro-foodwebs, such as zymography, application of fluorogenic substrates, enzymes kinetics, microbial growth, stable isotopes and lipid analysis • Response of soil microorganisms to environmental stressors	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Scheu
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

cf. examination regulations	6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.123: Project (research participation)**	6 C 4 WLH
Learning outcome, core skills: This course is a final step linking the data-set obtained and statistically treated by the students in practical trainings (B.MES. 105; 111; 113; B.MES-SK-115; 122) to the ongoing research projects. Introduction of structure, research strategy and outcome of the projects, from which the students have got the samples for practical training in previous semesters. Students compare their own results to the projects outcome. Course gives an advanced knowledge and application skills on the methods learnt within MES program (B.MES. 105; 111; 113; 115; 119; 122). Lecture course on Project design comprises all necessary steps to develop a scientific project: literature acquisition, research idea, scientific hypotheses, research strategy, design of the experiments (sites selection, sampling procedure, selection of methods), expected outcome and knowledge dissemination, time-table. Students develop and present their own projects for Bachelor study. This course is also aimed to help the students in preparation of their Bachelor study using as practical examples on-going projects of the department of “Soil Science of Temperate Ecosystems”.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Project design (Lectures and Seminar)** *Contents*: Lecture course on Project design. Seminar on the own contribution to research.	 2 WLH
2. Project (research participation) *Contents*: Laboratory courses work and/or active participation in ongoing research projects of lectures involved in the program.	2 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (10 pages max.)	6 C
Examination requirements: Scientific hypotheses, experimental design, laboratory techniques, analysis interpretation and scientific presentation of research results.	

Admission requirements: At least 120 credits earned	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Evgenia Blagodatskaya
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.301: Special topics in plant methods and ecological applications I**	6 C 4 WLH

Learning outcome, core skills: This elective module consists of a seminar and advanced method courses. In the seminar the students will be informed about recent development and new discoveries in forest botany, plant – microbial interactions, biotechnology, plant molecular genetics and practical applications. In the advanced method courses student undertake internships and/or field excursions to learn new methods and applications in plant physiology and ecology. The students will take responsibility in the organization of their study program.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Forest botany (Seminar)	2 WLH
2. Ecological applications / Field excursion (Lecture, practical)	2 WLH
Examination: Oral presentation (aaprox. 15 minutes) and written report (10 pages max.)	6 C

Examination requirements: Discussion of scientific presentations, knowledge in recent problems in Forest Botany, application of advanced scientific methods to selected problems in plant science. Skills: knowledge in critical text analyses and presentation skills, knowledge in data base research, practical skills in handling modern equipment for plant analyses.	

Admission requirements: none	**Recommended previous knowledge:** In-depth knowledge in biology is required
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module B.MES.302: Special topics in plant methods and ecological applications II**	6 C 4 WLH
Learning outcome, core skills: This elective module consists of a seminar and an advanced method course. The seminar will be conducted as a journal club. The students will get lists of papers which they have to read and present during the semester. The topics will be chosen from recent literature. The goal is to become involved in research and to learn to understand how to structure research and to publish. In the advanced method courses, lectures and specialized techniques will be taught and practiced. The students will organize the journal club.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Advanced plant biochemistry and genetics / Journal club (Seminar)**	 2 WLH
2. Advanced methods (Lecture, practical)	2 WLH
Examination: Oral presentation (approx. 15 minutes) and written report (10 pages max.)	6 C
Examination requirements: Reading and analyzing scientific publications, in-depth understanding of scientific working methods in plant ecology and molecular biology. Skills: knowledge in critical text analyses and presentation skills, knowledge in research methods.	

Admission requirements: none	**Recommended previous knowledge:** In-depth knowledge in biology is required
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module B.MES.303: Semiochemical diversity**	6 C 4 WLH

Learning outcome, core skills: Students will learn to investigate the dynamics of semiochemical diversity in different types of ecosystems. This involves field sampling of important plants and animals, volatile extraction from different tissues, laboratory analyses of various types of volatile markers, data analyses and interpretation. Students will learn practical steps to assess semiochemical diversity, and will be able to evaluate the use of chemo-ecological methods for applications in plant protection, nature conservation, and ecosystem management.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses: **1. Semiochemical diversity (Lecture)**	1 WLH
2. Methods to study semiochemical diversity and biodiversity (Workshop, laboratory course)	3 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements: Classification of semiochemicals, measures of chemical and biological diversity, analytical and determination methods, key species, key volatiles, key processes, semiochemicals in practical application.	

Admission requirements: B.MES.102	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.304: Protection of renewable resources**	6 C 4 WLH

Learning outcome, core skills: The use of chemical methods is commonplace in protection measures at various levels of biological organization in forest protection, plant protection and stored product protection. Students will learn the results of chemo-ecological approaches in integrated pest management based on selected projects and recent literature. Students will be able to critically evaluate benefits and limitations of chemo-ecological approaches in a production and conservation context. Examples will be taken from different geographic and climatic regions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Protection of renewable resources based on chemical and chemo-ecological methods (Lecture)	1 WLH
2. Assessment of protection measures for renewable resources (Seminar, workshop)	3 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (5 pages max.)	6 C

Examination requirements: Application of semiochemicals in different ecosystems, quality control, toxicology, integrated pest management, production of renewable resources, nature protection.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.305: Conservation of biodiversity**	6 C 4 WLH
Learning outcome, core skills: The use of molecular methods is commonplace in conservation at various levels of biological organization from genes to ecosystems. Students will examin the results of molecular approaches in biodiversity conservation based on selected projects and recent literature. Students will be able to critically evaluate benefits and limitations of molecular studies in a conservation context. Examples will be taken from different geographic and climatic regions.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Conservation of biodiversity based on molecular tools (Lecture)** **2. Assessment of molecular diversity for conservation (Seminar, Workshop)**	 1 WLH 3 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (5 pages max.)	6 C
Examination requirements: Effective comprehension of scientific literature with regard to conservation of biodiversity, different methods used for conservation of biodiversity and their specific applications, critical evaluation of molecular studies in a conservation context.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.306: Intraspecific diversity of plants**	6 C 4 WLH
Learning outcome, core skills: Students will learn to investigate the dynamics of intraspecific diversity in different types of ecosystems. This involves field sampling of important plants, DNA extraction from different tissues, laboratory analyses with various types of molecular markers, data analyses and interpretation. Students will learn practical steps to assess genetic diversity, and will be able to evaluate the use of DNA-based methods for applications in breeding, conservation, and ecosystem management.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Intraspecific diversity of plants** (Lecture)	 1 WLH
2. DNA based methods to study biodiversity (Workshops, laboratory exercise)	3 WLH
Examination: Term paper (20 pages max.)	6 C
Examination requirements: DNA markers and techniques, estimation of intraspecific diversity in different types of ecosystems, methods used for experimental sampling, DNA extraction from different tissues, laboratory techniques, data analyses and interpretation and application of results.	

Admission requirements: B.MES.103, B.MES.104	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.Mat.0922: Mathematics information services and electronic publishing**	3 C (Anteil SK: 3 C) 2 WLH

Learning outcome, core skills: **Learning outcome:** After having successfully completed the module, students are familiar with the basics of mathematics information services and electronic publishing. They • work with popular information services in mathematics and with conventional, non-electronic as well as electronic media; • know a broad spectrum of mathematical information sources including classification principles and the role of meta data; • are familiar with current development in the area of electronic publishing in the subject mathematics. **Core skills:** After successfull completion of the module students have acquired subject-specific information competencies. They • have suitable research skills; • are familiar with different information and specific publication services.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture) *Contents*: Lecture course with project report	

Examination: Written examination (90 minutes), not graded **Examination prerequisites:** Committed participation in the course	3 C

Examination requirements: Application of the acquired skills in individual projects in the area of mathematical information services and electronic publishing	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 1 - 6; Master: 1 - 4; Promotion: 1 - 6
Maximum number of students: not limited	

Additional notes and regulations:

Instructors: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3043: Non-life insurance mathematics**	6 C 4 WLH
Learning outcome, core skills: Non-life insurance mathematics deals with models and methods of quantifying risks with both, the occurrence of the loss and its amount showing random patterns. In particular the following problems are to be solved: • determing appropriate insurance premiums, • calculate adequate loss reserves, • determine how to allocate risk between policyholder and insurer resp. insurer and reinsurers. **Learning Outcomes** The aim of the module is to equip students with knowledge in four areas: 1. risk models, 2. pricing, 3. reserving, 4. risk sharing. After completion of the module students are familiar with fundamental terms and methods of non-life insurance mathematics. They • are familiar with and able to handle essential definitions and terms within non-life insurance mathematics; • have an overview of the most valuables problem statements of non-life insurance; • understand central aspects of risk theory; • know substantial pricing and reserving methods, • estimate ruin probabilities; • are acquainted with the most important reinsurance forms and reinsurance pricing methods. **Competencies** After successful completion of the module students have acquired fundamental competencies within non-life insurance. They are able to • evaluate and quantify fundamental risks, • model the aggregate loss with individual or collective model, • apply a basic reserve of solving approaches, • analyse and develop pricing models which mathematically are state of the art, • apply different reserving methods and calculate outstanding losses, • assess reinsurance contracts.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture course with problem session	4 WLH
Examination: Written examination (120 minutes)	6 C
Examination requirements: Basic knowledge of non-life insurance mathematics	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: Lecturers of the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3044: Life insurance mathematics	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
This module deals with the basics of the different branches in life insurance mathematics.In particular, the students get to know both the classical deterministic model and the stochastic model as well as how to apply them to problems relevant in the respective branch. On this base the students describe essential notions of present values, premiums and their present values as well as the actuarial reserve. **Learning outcomes:** After successfully completing this module students are familiar with fundamental terms and methods of life insurance mathematics. In particular they • assess cashflows within financial and insurance mathematics, • apply methods of life insurance mathematics to problems from theory and practise. • characterise financial secutiries and insurance contracts in terms of cashflows, • have an overview of the most valuables problem statements of life insurance, • understand the stochastic interest structure, • master fundamental terms and notions of life insurance mathematics, • get an overwiew of most important problems in life insurance mathematics, • understand mortality tables and leaving orders within pension insurance, • know substantial pricing and reserving methods, • know the economic and legal requirements of private health insurance in Germany, • are acquainted with per-head loss statistics, present value factor calculation and biometric accounting priciples. **Competencies:** A student who completes this module successfully should have acquired fundamental competencies within life insurance. The student should be able to • assess cashflows with respect to both collateral and risk under deterministic interest structure, • calculating premiums and provisions in life -, health- and pension-insurance, • understand the actuarial equivalence principle as base of actuarial valuation in life insurance, • apply and understand the actuarial equivalence principle for calculating premiums, actuarial reserves and ageing provisions, • calculate profit participation in life insurance, • master premium calculation in health-insurance, • calculate present value and settlement value of pension obligations, • find mathematical solutions to practical questions in life, health and pension insurance.	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course with problem session	4 WLH

Examination: Written examination (120 minutes)	6 C

Examination requirements:	

Basic knowledge of life insurance mathematics	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: Lecturers of the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3111: Introduction to analytic number theory**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Analytical number theory"; • explain basic ideas of proof in the area "Analytical number theory"; • illustrate typical applications in the area "Analytical number theory".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3111.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of knowledge and mastery of basic competencies in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3112: Introduction to analysis of partial differential equations**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalized functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Analysis of partial different equations"; • explain basic ideas of proof in the area "Analysis of partial different equations"; • illustrate typical applications in the area "Analysis of partial different equations".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3112.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3113: Introduction to differential geometry**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, areas and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Differential geometry"; • explain basic ideas of proof in the area "Differential geometry"; • illustrate typical applications in the area "Differential geometry".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3113.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3114: Introduction to algebraic topology**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students • know the basic concepts of set-theoretic topology and continuous mappings; • construct new topologies from given topologies; • know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds; • apply basic concepts of category theory to topological spaces; • use concepts of functors to obtain algebraic invariants of topological spaces and mappings; • know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them; • know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems; • calculate homology and cohomology with the aid of chain complexes; • deduce algebraic characteristics of homology and cohomology with the aid of homological algebra; • become acquainted with connections between analysis and topology; • apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Algebraic topology"; • explain basic ideas of proof in the area "Algebraic topology"; • illustrate typical applications in the area "Algebraic topology".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH

2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3114.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3115: Introduction to mathematical methods in physics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are • harmonic analysis, algebraic structures and representation theory, (group) effects; • operator algebra, C* algebra and von-Neumann algebra; • operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions; • (semi) Riemannian geometry, symplectic and Poisson geometry, quantization. One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Mathematical methods of physics"; • explain basic ideas of proof in the area "Mathematical methods of physics"; • illustrate typical applications in the area "Mathematical methods of physics".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3115.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Mathematical methods in physics"	

Admission requirements:	**Recommended previous knowledge:**

none	B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3121: Introduction to algebraic geometry	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Algebraic geometry"; • explain basic ideas of proof in the area "Algebraic geometry"; • illustrate typical applications in the area "Algebraic geometry".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes)	9 C

Examination prerequisites: B.Mat.3121.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3122: Introduction to algebraic number theory	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students

- know Noetherian and Dedekind rings and the class groups;
- are familiar with discriminants, differents and bifurcation theory of Hilbert;
- know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL);
- are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues;
- know densities, the Tchebotarew theorem and applications;
- work with orders, S-integers and S-units;
- know the class field theory of Hilbert, Takagi and Idele theoretical field theory;
- are familiar with Zp-extensions and their Iwasawa theory;
- discuss the most important hypotheses of Iwasawa theory and their consequences.

Concerning algorithmic aspects of number theory, the following competencies are pursued. Students

- work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors;
- are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests;
- use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics;
- discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields;
- calculate class groups and fundamental units;
- calculate Galois groups of absolute number fields.

Core skills:

After having successfully completed the module, students will be able to

- discuss basic concepts of the area "Algebraic number theory";
- explain basic ideas of proof in the area "Algebraic number theory";
- illustrate typical applications in the area "Algebraic number theory".

Workload:
Attendance time:
84 h
Self-study time:
186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3122.Ue:Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3123: Introduction to algebraic structures	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Algebraic structures"; • explain basic ideas of proof in the area "Algebraic structures"; • illustrate typical applications in the area "Algebraic structures".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:**	9 C

B.Mat.3123.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3124: Introduction to groups, geometry and dynamical systems**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Groups, geometry and dynamical systems"; • explain basic ideas of proof in the area "Groups, geometry and dynamical systems"; • illustrate typical applications in the area "Groups, geometry and dynamical systems".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3124.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3125: Introduction to non-commutative geometry	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students

- are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory;
- construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains;
- know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it;
- know important examples of simple C*-algebras and deduce their basic characteristics;
- apply basic concepts of category theory to C*-algebras;
- model the symmetries of non-commutative spaces;
- apply Hilbert modules in C*-algebras;
- know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it;
- apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales;
- compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them;
- classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations;
- classify W*-algebras and know the intrinsic dynamic of factors;
- apply von Neumann algebras to the axiomatic formulation of quantum field theory;
- use von Neumann algebras for the construction of L2 invariants for manifolds and groups;
- understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups;
- define the invariants of algebras and modules with chain complexes and their homology and calculate these;

Workload:

Attendance time:

84 h

Self-study time:

186 h

• interpret these homological invariants geometrically and correlate them with each other; • abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Non-commutative geometry"; • explain basic ideas of proof in the area "Non-commutative geometry"; • illustrate typical applications in the area "Non-commutative geometry".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3125.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1100, B.Mat.1200
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3131: Introduction to inverse problems**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems; • evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors; • analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators; • analyse the convergence of regularisation methods with the help of complex analysis; • analyse regularisation methods from stochastic error models; • apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems; • model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region; • analyse the uniqueness and conditional stability of inverse problems of partial differential equations; • deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods; • formulate mathematical models of medical imaging like computed tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Inverse problems"; • explain basic ideas of proof in the area "Inverse problems"; • illustrate typical applications in the area "Inverse problems".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3131.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3132: Introduction to approximation methods**	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces;
- can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces;
- know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions;
- acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data;
- are informed about current developments of efficient data approximation and data analysis;
- adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved.

Core skills:

After having successfully completed the module, students will be able to

- discuss basic concepts of the area "Approximation methods";
- explain basic ideas of proof in the area "Approximation methods" for one- and multidimensional data;
- illustrate typical applications in the area of data approximation and data analysis.

Workload:

Attendance time:

84 h

Self-study time:

186 h

Courses:	
1. Lecture course (Lecture)	4 WLH

2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3132.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3133: Introduction to numerics of partial differential equations**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution; • know the basics of the theory of linear integral equations; • are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM); • analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems; • apply methods for adaptive lattice refinement on the basis of a posteriori error approximations; • know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation; • apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems; • apply available software for the solution of partial differential equations and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations; • know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Numerics of partial differential equations"; • explain basic ideas of proof in the area "Numerics of partial differential equations"; • illustrate typical applications in the area "Numerics of partial differential equations".	Attendance time: 84 h Self-study time: 186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3133.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Numerics of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module B.Mat.3134: Introduction to optimisation	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- identify optimisation problems in application-oriented problems and formulate these as mathematical programmes;
- evaluate the existence and uniqueness of the solution of an optimisation problem;
- identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set;
- know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised;
- analyse the complexity of an optimisation problem;
- classify a mathematical programme in a class of optimisation problems and know current solution strategies for it;
- develop optimisation methods and adapt general methods to special problems;
- deduce upper and lower bounds for optimisation problems and understand their meaning;
- understand the geometrical structure of an optimisation problem and apply it for solution strategies;
- distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times;
- acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation;
- acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning;
- handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems.

Core skills:

After having successfully completed the module, students will be able to

- discuss basic concepts of the area "Optimisation";
- explain basic ideas of proof in the area "Optimisation";
- illustrate typical applications in the area "Optimisation".

Workload:

Attendance time:
84 h

Self-study time:
186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3134.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module B.Mat.3137: Introduction to variational analysis	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	**Workload:** Attendance time: 84 h Self-study time: 186 h

After having successfully completed the module, students will be able to • discuss basic concepts of the area "Variational analysis"; • explain basic ideas of proof in the area "Variational analysis"; • illustrate typical applications in the area "Variational analysis".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) (120 minutes) **Examination prerequisites:** B.Mat.3137.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module B.Mat.3138: Introduction to image and geometry processing	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces;
- learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces;
- learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform;
- learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces;
- acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies;
- know basic concepts and methods of topology;
- are familiar with visualisation software;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- know which special characteristics of an image or of a geometry can be extracted and worked on with which methods;
- evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data;
- are informed about current developments of efficient geometrical and topological data analysis;
- adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data.

Core skills:

After having successfully completed the module, students will be able to

- discuss basic concepts of the area "Image and geometry processing";
- explain basic ideas of proof in the area "Image and geometry processing";
- illustrate typical applications in the area "Image and geometry processing".

Workload:

Attendance time:

84 h

Self-study time:

186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3138.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3139: Introduction to scientific computing / applied mathematics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Scientific computing / applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / Applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Scientific computing / applied mathematics"; • explain basic ideas of proof in the area "Scientific computing / applied mathematics"; • illustrate typical applications in the area "Scientific computing / applied mathematics".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Internship, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3139.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of knowledge and mastery of basic competencies in the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3141: Introduction to applied and mathematical stochastics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Applied and mathematical stochastics"; • explain basic ideas of proof in the area "Applied and mathematical stochastics"; • illustrate typical applications in the area "Applied and mathematical stochastics".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3141.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3142: Introduction to stochastic processes	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces; • understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes; • know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes; • analyse regularity characteristics of the paths of stochastic processes; • construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics; • are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms; • analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems; • formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics; • are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes; • know fundamental convergence theorems for stochastic processes and generalise these; • model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes; • analyse models in mathematical economics and finance and understand evaluation methods for financial products. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Stochastic processes";	**Workload:** Attendance time: 84 h Self-study time: 186 h

• explain basic ideas of proof in the area "Stochastic processes"; • illustrate typical applications in the area "Stochastic processes".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3142.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3143: Introduction to stochastic methods of economathematics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Stochastic methods of economathematics"; • explain basic ideas of proof in the area "Stochastic methods of economathematics"; • illustrate typical applications in the area "Stochastic methods of economathematics".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3143.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Stochastic methods of economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator

Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3144: Introduction to mathematical statistics	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics;
- evaluate statistical methods mathematically precisely via suitable risk and loss concepts;
- analyse optimality characteristics of statistical estimate methods via lower and upper bounds;
- analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory;
- are familiar with basic statistical distribution models that base on the theory of exponential indexed families;
- know different techniques to obtain lower and upper risk bounds in these models;
- are confident in modelling typical data structures of regression;
- analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand;
- are able to mathematically analyse resampling methods and apply them purposively;
- are familiar with advanced tools of non-parametric statistics and empirical process theory;
- independently become acquainted with a current topic of mathematical statistics;
- evaluate complex statistical methods and enhance them in a problem-oriented way.

Core skills:

After having successfully completed the module, students will be able to

- discuss basic concepts of the area "Mathematical statistics";
- explain basic ideas of proof in the area "Mathematical statistics";
- illustrate typical applications in the area "Mathematical statistics".

Workload:

Attendance time:
84 h

Self-study time:
186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3144.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3145: Introduction to statistical modelling and inference**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods the model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Statistical modelling and inference"; • explain basic ideas of proof in the area "Statistical modelling and inference"; • illustrate typical applications in the area "Statistical modelling and inference".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, oral examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3145.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of knowledge and mastery of basic competencies in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3146: Introduction to multivariate statistics**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistic modelling as well as estimate and test theory; • understand the basics of multivariate statistics; • know the main features of the theory of empirical processes; • master basic methods of multivariate extreme value theory; • understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas; • are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces; • are especially familiar with concepts and methods of directional analysis and statistical shape analysis; • apply statistical methods for data on manifolds and stratified spaces; • are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Multivariate statistics"; • explain basic ideas of proof in the area "Multivariate statistics"; • illustrate typical applications in the area "Multivariate statistics".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Written or oral exam, written examination (120 minutes) or oral examination (appr. 20 minutes) **Examination prerequisites:** B.Mat.3146.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of knowledge and mastery of basic competencies in the area "Multivariate statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3311: Advances in analytic number theory	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Analytic number theory" confidently; • explain complex issues of the area "Analytic number theory"; • apply methods of the area "Analytic number theory" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3311.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3111
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3111 "Introduction to analytic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3312: Advances in analysis of partial differential equations**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalised functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Analysis of partial differential equations" confidently; • explain complex issues of the area "Analysis of partial differential equations"; • apply methods of the area "Analysis of partial differential equations" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3312.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3112
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3112 "Introduction to analysis of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3313: Advances in differential geometry	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, surfaces and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Differential geometry" confidently; • explain complex issues of the area "Differential geometry"; • apply methods of the area "Differential geometry" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3313.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3113
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3113 "Introduction to differential geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3314: Advances in algebraic topology**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students • know the basic concepts of set-theoretic topology and continuous mappings; • construct new topologies from given topologies; • know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds; • apply basic concepts of category theory to topological spaces; • use concepts of functors to obtain algebraic invariants of topological spaces and mappings; • know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them; • know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems; • calculate homology and cohomology with the aid of chain complexes; • deduce algebraic characteristics of homology and cohomology with the aid of homological algebra; • become acquainted with connections between analysis and topology; • apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Algebraic topology" confidently; • explain complex issues of the area "Algebraic topology"; • apply methods of the area "Algebraic topology" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses: **1. Lecture course** (Lecture)	 4 WLH

2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3314.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3114
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3114 "Introduction to algebraic topology"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3315: Advances in mathematical methods in physics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are • harmonic analysis, algebraic structures and representation theory, (group) effects; • operator algebra, C* algebra and von-Neumann algebra; • operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions; • (semi) Riemannian geometry, symplectic and Poisson geometry, quantization. One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Mathematical methods in physics" confidently; • explain complex issues of the area "Mathematical methods in physics"; • apply methods of the area "Mathematical methods in physics" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3315.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Mathematical methods in physics"	

Admission requirements:	**Recommended previous knowledge:**

none	B.Mat.3115
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: on an irregular basis	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3321: Advances in algebraic geometry**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Algebraic geometry" confidently; • explain complex issues of the area "Algebraic geometry"; • apply methods of the area "Algebraic geometry" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:**	9 C

B.Mat.3321.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3121
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3121 "Introduction to algebraic geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3322: Advances in algebraic number theory	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students • know Noetherian and Dedekind rings and the class groups; • are familiar with discriminants, differents and bifurcation theory of Hilbert; • know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL); • are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues; • know densities, the Tchebotarew theorem and applications; • work with orders, S-integers and S-units; • know the class field theory of Hilbert, Takagi and Idele theoretical field theory; • are familiar with Zp-extensions and their Iwasawa theory; • discuss the most important hypotheses of Iwasawa theory and their consequences. Concerning algorithmic aspects of number theory, the following competencies are pursued. Students • work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors; • are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests; • use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics; • discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields; • calculate class groups and fundamental units; • calculate Galois groups of absolute number fields. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Algebraic number theory" confidently; • explain complex issues of the area "Algebraic number theory"; • apply methods of the area "Algebraic number theory" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3322.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessionsungen	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3122
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3122 "Introduction to algebraic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute	

Georg-August-Universität Göttingen Module B.Mat.3323: Advances in algebraic structures	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Algebraic structures" confidently; • explain complex issues of the area "Algebraic structures"; • apply methods of the area "Algebraic structures" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes)	9 C
Examination prerequisites:	

B.Mat.3323.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3123
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3123 "Introduction to algebraic structures"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module B.Mat.3324: Advances in groups, geometry and dynamical systems**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Groups, geometry and dynamical systems" confidently; • explain complex issues of the area "Groups, geometry and dynamical systems"; • apply methods of the area "Groups, geometry and dynamical systems" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3324.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3124
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3124 "Introduction to groups, geometry and dynamical systems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3325: Advances in non-commutative geometry	9 C 6 WLH

Learning outcome, core skills:	Workload:

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students

- are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory;
- construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains;
- know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it;
- know important examples of simple C*-algebras and deduce their basic characteristics;
- apply basic concepts of category theory to C*-algebras;
- model the symmetries of non-commutative spaces;
- apply Hilbert modules in C*-algebras;
- know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it;
- apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales;
- compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them;
- classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations;
- classify W*-algebras and know the intrinsic dynamic of factors;
- apply von Neumann algebras to the axiomatic formulation of quantum field theory;
- use von Neumann algebras for the construction of L2 invariants for manifolds and groups;
- understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups;
- define the invariants of algebras and modules with chain complexes and their homology and calculate these;

Workload:

Attendance time:

84 h

Self-study time:

186 h

• interpret these homological invariants geometrically and correlate them with each other; • abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Non-commutative geometry" confidently; • explain complex issues of the area "Non-commutative geometry"; • apply methods of the area "Non-commutative geometry" to new problems in this area.	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3325.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3125
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3125 "Introduction to non-commutative geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module B.Mat.3331: Advances in inverse problems	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems;
- evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors;
- analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators;
- analyse the convergence of regularisation methods with the help of complex analysis;
- analyse regularisation methods from stochastic error models;
- apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems;
- model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region;
- analyse the uniqueness and conditional stability of inverse problems of partial differential equations;
- deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods;
- formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators.

Core skills:

After having successfully completed the module, students will be able to

- handle methods and concepts of the area "Inverse problems" confidently;
- explain complex issues of the area "Inverse problems";
- apply methods of the area "Inverse problems" to new problems in this area.

Workload:

Attendance time:

84 h

Self-study time:

186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3331.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3131
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3131 "Introduction to inverse problems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3332: Advances in approximation methods**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Approximation methods" confidently; • explain complex issues of the area "Approximation methods"; • apply methods of the area "Approximation methods" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3332.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3132
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3132 "Introduction to approximation methods"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3333: Advances in numerics of partial differential equations**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution; • know the basics of the theory of linear integral equations; • are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM); • analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems; • apply methods for adaptive lattice refinement on the basis of a posteriori error approximations; • know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation; • apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems; • apply available software for the solution of partial differential equations and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations; • know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Numerics of partial differential equations" confidently; • explain complex issues of the area "Numerics of partial differential equations";	Attendance time: 84 h Self-study time: 186 h

• apply methods of the area "Numerics of partial differential equations" to new problems in this area.	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3333.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Numerics of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3133
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3133 "Introduction to numerics of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module B.Mat.3334: Advances in optimisation	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • identify optimisation problems in application-oriented problems and formulate these as mathematical programmes; • evaluate the existence and uniqueness of the solution of an optimisation problem; • identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set; • know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised; • analyse the complexity of an optimisation problem; • classify a mathematical programme in a class of optimisation problems and know current solution strategies for it; • develop optimisation methods and adapt general methods to special problems; • deduce upper and lower bounds for optimisation problems and understand their meaning; • understand the geometrical structure of an optimisation problem and apply it for solution strategies; • distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times; • acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation; • acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning; • handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Optimisation" confidently; • explain complex issues of the area "Optimisation"; • apply methods of the area "Optimisation" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3334.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3134
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3134 "Introduction to optimisation"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module B.Mat.3337: Advances in variational analysis	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in the area of "Variational analysis" and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	**Workload:** Attendance time: 84 h Self-study time: 186 h

After having successfully completed the module, students will be able to • handle methods and concepts of the area "Variational analysis" confidently; • explain complex issues of the area "Variational analysis"; • apply methods of the area "Variational analysis" to new problems in this area.	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3337.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3137
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3137 "Introduction in variational analysis"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3338: Advances in image and geometry processing**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces; • learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces; • learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform; • learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces; • acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies; • know basic concepts and methods of topology; • are familiar with visualisation software; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • know which special characteristics of an image or of a geometry can be extracted and worked on with which methods; • evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data; • are informed about current developments of efficient geometrical and topological data analysis; • adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Image and geometry processing" confidently; • explain complex issues of the area "Image and geometry processing";	Attendance time: 84 h Self-study time: 186 h

• apply methods of the area "Image and geometry processing" to new problems in this area.	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3338.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3138
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3138 "Introduction to image and geometry processing"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3339: Advances in scientific computing / applied mathematics**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Scientific computing / Applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / Applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Scientific computing / applied mathematics" confidently; • explain complex issues of the area "Scientific computing / applied mathematics"; • apply methods of the area "Scientific computing / applied mathematics" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3339.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3139
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3139 "Introduction to scientific computing / applied mathematics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module B.Mat.3341: Advances in applied and mathematical stochastics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Applied and mathematical stochastics" confidently; • explain complex issues of the area "Applied and mathematical stochastics"; • apply methods of the area "Applied and mathematical stochastics" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3341.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3141
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3141 "Introduction to applied and mathematical stochastics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3342: Advances in stochastic processes	9 C 6 WLH

Learning outcome, core skills:	Workload:

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with advanced concepts of probability theory established on measure theory and apply them independently;
- know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces;
- understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes;
- know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes;
- analyse regularity characteristics of the paths of stochastic processes;
- construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics;
- are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms;
- analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems;
- formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics;
- are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes;
- know fundamental convergence theorems for stochastic processes and generalise these;
- model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes;
- analyse models in mathematical economics and finance and understand evaluation methods for financial products.

Core skills:

After having successfully completed the module, students will be able to

- handle methods and concepts of the area "Stochastic processes" confidently;

Workload:

Attendance time:
84 h
Self-study time:
186 h

• explain complex issues of the area "Stochastic processes"; • apply methods of the area "Stochastic processes" to new problems in this area.	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3342.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3142
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3142 "Introduction to stochastic processes"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3343: Advances in stochastic methods of economathematics**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Stochastic methods of economathematics" confidently; • explain complex issues of the area "Stochastic methods of economathematics"; • apply methods of the area "Stochastic methods of economathematics" to new problems in this area.	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3343.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Stochastic methods of economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3143
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

Usually subsequent to the module B.Mat.3143 "Introduction to stochastic methods of economathematics"	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module B.Mat.3344: Advances in mathematical statistics**	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics;
- evaluate statistical methods mathematically precisely via suitable risk and loss concepts;
- analyse optimality characteristics of statistical estimate methods via lower and upper bounds;
- analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory;
- are familiar with basic statistical distribution models that base on the theory of exponential indexed families;
- know different techniques to obtain lower and upper risk bounds in these models;
- are confident in modelling typical data structures of regression;
- analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand;
- are able to mathematically analyse resampling methods and apply them purposively;
- are familiar with advanced tools of non-parametric statistics and empirical process theory;
- independently become acquainted with a current topic of mathematical statistics;
- evaluate complex statistical methods and enhance them in a problem-oriented way.

Core skills:

After having successfully completed the module, students will be able to

- handle methods and concepts of the area "Mathematical statistics" confidently;
- explain complex issues of the area "Mathematical statistics";
- apply methods of the area "Mathematical statistics" to new problems in this area

Workload:

Attendance time:
84 h
Self-study time:
186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3344.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3144
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3144 "Introduction to mathematical statistics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3345: Advances in statistical modelling and inference	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods for model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Statistical modelling and inference" confidently; • explain complex issues of the area "Statistical modelling and inference"; • apply methods of the area "Statistical modelling and inference" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3345.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3145
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3111 "Introduction to statistical modelling and inference"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Mat.3346: Advances in multivariate statistics	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistic modelling as well as estimate and test theory; • understand the basics of multivariate statistics; • know the main features of the theory of empirical processes; • master basic methods of multivariate extreme value theory; • understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas; • are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces; • are especially familiar with concepts and methods of directional analysis and statistical shape analysis; • apply statistical methods for data on manifolds and stratified spaces; • are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose. **Core skills:** After having successfully completed the module, students will be able to • handle methods and concepts of the area "Multivariate statistics" confidently; • explain complex issues of the area "Multivariate statistics"; • apply methods of the area "Multivariate statistics" to new problems in this area.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** B.Mat.3346.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of advancement of knowledge and competencies acquired in the introductory module of the area "Multivariate statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3146
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3146 "Introduction to multivariate statistics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module B.Phy.1512: Particle physics II - of and with quarks	6 C 6 WLH

Learning outcome, core skills: After successful completion of this module, students should be familiar with the properties and interactions of quarks as well as with experimental methods and experiments which lead to their discovery and are used for precise studies.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Courses:	
1. Particle physics II - of and with quarks (Lecture)	4 WLH
2. Particle physics II - of and with quarks (Exercise)	2 WLH

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Concepts and methods along with specific implementations of statistical methods in data analysis. Properties and discovery of quarks, discovery of W and Z bosons at hadron colliders, the top-quark, CKM mixing matrix, decays of heavy quarks, quark mixing and oscillations, CP-violation, jets, gluons and fragmentation, deep-inelastic scattering, QCD tests and measurement of the strong coupling alpha_s.	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen Module B.Phy.1522: Solid State Physics II	6 C 4 WLH
Learning outcome, core skills: After successful completion of this Module students will be able to work with advanced concepts, phenomena and models of solid state physics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Solid State Physics II	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Examination topics: Basics, phenomena and models for electrons and lattice dynamics in solids. Concepts of quasi-particle interaction: Transport phenomena incl. electrical and thermal conductivity, dielectric properties. Semiconductors, magnetic properties of solids, superconductivity.	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to solid state physics
Language: German, English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 120	

Georg-August-Universität Göttingen **Module B.Phy.1551: Introduction to Astrophysics**	8 C 6 WLH

Learning outcome, core skills: After successful completion of the modul students should be familiar with the basic concepts of astrophysics in observation and theory.	**Workload:** Attendance time: 84 h Self-study time: 156 h

Course: Lecture and exercises for introduction to astrophysics	
Examination: Written examination (120 minutes) **Examination prerequisites:** At least 50% of the homework of the excercises have to be solved successfully. **Examination requirements:** Observational techniques, Planets and exoplanets, planet formation, stellar formation, structure and evolution, galaxies, AGN and quasars, cosmology, structure formation	8 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Wolfram Kollatschny
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1
Maximum number of students: 120	

Additional notes and regulations:

Special Regulations for students of Master of Education:

- Exercises will take place in German.
- Exam will be in German.

Georg-August-Universität Göttingen **Module B.Phy.1561: Introduction to Physics of Complex Systems**	8 C 6 WLH

Learning outcome, core skills: Sound knowledge of essential methods and concepts from Nonlinear Dynamics and Complex Systems Theory, including practical skills for analysis and simulation (using, for example, the programming language python) of dynamical systems.	**Workload:** Attendance time: 84 h Self-study time: 156 h

Courses:	
1. Introduction to Physics of Complex Systems (Lecture)	4 WLH
2. Introduction to Physics of Complex Systems (Exercise)	2 WLH

Examination: written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** • Knowledge of fundamental principles and methods of Nonlinear Physics • Modern experimental techniques and theoretical models of Complex Systems theory.	8 C

Admission requirements: none	**Recommended previous knowledge:** Basic programming skills (for the exercises)
Language: English, German	**Person responsible for module:** apl. Prof. Dr. Ulrich Parlitz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 2
Maximum number of students: 120	

Georg-August-Universität Göttingen **Module B.Phy.1571: Introduction to Biophysics**	8 C 6 WLH

Learning outcome, core skills: After attending this course, students will be familiar with basic concepts and phenomena, theoretical descriptions, and experimental methods in biophysics.	**Workload:** Attendance time: 84 h Self-study time: 156 h

Courses:	
1. Introduction to Biophysics (Lecture) *Contents*: components of the cell; diffusion, Brownian motion and random walks; low Reynolds number hydrodynamics; chemical reactions, cooperativity and enzymes; biomolecular interaction forces and self-assembly; membranes; polymer physics and mechanics of the cytoskeleton; neurobiophysics; experimental methods and microscopy	4 WLH
2. Introduction to Biophysics (Exercise)	2 WLH

Examination: Written exam (120 min.) or oral exam (ca. 30 min.) **Examination prerequisites:** At least 50% of the homework of the excercises have to be solved successfully. **Examination requirements:** Knowledge of the fundamental principles, theoretical descriptions and experimental methods of biophysics.	8 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Jörg Enderlein
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 2
Maximum number of students: 100	

Georg-August-Universität Göttingen Module B.Phy.5503: Astrophysical Spectroscopy	3 C 2 WLH
Learning outcome, core skills: After successful completion of the modul the students should ... • know astronomial telescopes and measurement techniques • have an understanding of spectroscopic observation techniques • know principles of spectroscopy and design of astronomical spectrographs • know planning and execution of astronomical observations • data reduction and analysis	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture (Lecture) *Contents*: Astrophysical Spectroscopy	
Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Knowledge of astronomical spectroscopy, telescopes, image errors, instrumentation; observation, reduction and analysis of spectroscopic data.	3 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Astrophysics
Language: German, English	**Person responsible for module:** Prof. Dr. Ansgar Reiners
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module B.Phy.5505: Data Analysis in Astrophysics**	3 C 2 WLH

Learning outcome, core skills: After successful completion of the modul students are able to model noise and signal.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Vorlesung (Lecture)	

Examination: Oral examination (approx. 30 minutes)	3 C

Examination requirements: Demonstrate an understanding of concepts developed in lecture: Introduction to methods of data analysis in astrophysics: Random signal and noise; correlation analysis; model fitting by least squares and maximum likelihood; Monte Carlo simulations; Fourier analysis; filtering; signal and image processing; Hilbert transform; mapping; applications to problems of astrophysical relevance.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module B.Phy.5511: Magnetohydrodynamics**	3 C 2 WLH

Learning outcome, core skills: After successful comletion of this module, students should be able to apply the fundamental concepts and methods of magnetohydrodynamics to geo- and astrophysical problems.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture (Lecture)	

Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Demonstrate an understanding of the most important subjects treated during the lecture: The induction equation, the dynamo effect, mean field magnetohydrodynamics, Alfven-waves	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Andreas Tilgner
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5512: Low-mass stars, brown dwarfs, and planets**	3 C 2 WLH

Learning outcome, core skills: After successful completion of the modul students should be familiar with concepts of stellar and planetary astrophysics and should know how to applicate physical concepts in an astrophysical context.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture (Lecture)	

Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Formation, evolution, structure, and atmospheres of low-mass stars and sub-stellar objects; detection and characterization methods	3 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to astrophysics.
Language: German, English	**Person responsible for module:** Prof. Dr. Stefan Dreizler
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 3
Maximum number of students: 40	

Georg-August-Universität Göttingen Module B.Phy.5513: Numerical fluid dynamics	6 C 4 WLH
Learning outcome, core skills: After completion of this module students should ... • know the basic methods for solving partial differential equations • be able to program and analyze numerical methods for the solution of partial differential equations.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture with exercises	
Examination: Written report (max. 15 S.) or oral examination (approx. 30 Min.) **Examination requirements:** Basic programming skills. Finite difference, finite volume, finite element and spectral methods. Explicit and implicit time steps. Stability analysis.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Andreas Tilgner
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5514: Physics of the Interior of the Sun and Stars**	3 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should be able ... • to understand the equations of stellar structure, • to understand current questions about the physics of solar/stellar interiors and magnetism, • to understand the physics of solar/stellar oscillations and their diagnostic potential.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Vorlesung (Lecture)	
Examination: Oral examination (approx. 30 minutes)	3 C
Examination requirements: Demonstrate an understanding of concepts developed in lecture: Introduction to stellar structure, evolution, and dynamics; rotation; convection; dynamos; observations of solar and stellar oscillations; introduction to stellar pulsations; normal modes; weak perturbation theory; numerical forward modeling	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 3
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module B.Phy.5517: Physics of the Sun, Heliosphere and Space Weather: Key Knowledge**	3 C 2 WLH

Learning outcome, core skills: Introduction into the basics concepts of solar and heliospheric physics	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Vorlesung (Lecture)	

Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Basic processes in solar and heliospheric physics	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Ansgar Reiners Contact Person: Dr. Bothmer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5518: Physics of the Sun, Heliosphere and Space Weather: Space Weather Applications**	3 C 2 WLH
Learning outcome, core skills: Learning outcome: Introduction into the physics processes of space weather based on applied study cases. Core skills: Knowledge about physical processes of space weather and its applications. Ability in self-organised solving of case studies.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Vorlesung (Lecture)	
Examination: Oral examination (approx. 30 Min.) or written examination (120 Min.) **Examination requirements:** Knowledge about physical processes of space weather.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Ansgar Reiners Contact person: Dr. Bothmer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5522: Solar Eclipses and Physics of the Corona**	3 C 2 WLH
Learning outcome, core skills: After successfully completed the modul students should understand the basic processes on how a cool star can heat and sustain its million Kelvin hot outer atmosphere, the corona. Using basic concepts of magnetohydrodynamics they should also be able to explain the structure and dynamics of the corona.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture (Lecture)	
Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Understanding of basic physical process in the corona of a star. The exam will be based on excecises distributed during the lecture course. Phenomenology of solar eclipses, timing of eclipses; Physics of hot gases; interaction of gas and magnetic field in the outer atmosphere of the Sun and other stars; phyiscal processes for plasma heating („coronal heating“); wave and Ohmic heating, acceleration of plasma to form a solar wind, solar-terrestrial relations	3 C

Admission requirements: none	**Recommended previous knowledge:** -Introduction to astrophysics - Electrodynamics
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Hardi Peter
Course frequency: every 4th semester; summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5523: General Relativity**	6 C 6 WLH

Learning outcome, core skills: **Learning outcome:** Basic structures of Differential Geometry, Einstein's equation and underlying principles, Schwarzschild space-time and classical tests of General Relativity, black holes, gravitational waves, foundations of cosmology **Core skills:** The students shall master the foundations of General Relativity mathematically and physically. They shall be able to perform corresponding computations in simple models.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Courses:	
1. Lecture (Lecture)	4 WLH
2. Excercises	2 WLH

Examination: Written examination (120 minutes) **Examination requirements:** Basic structures of Differential geometry, simple examles of computations, Einstein's equation, underlying principles, Schwarzschild space-time, classical tests of General Relativity, foundations of cosmology.	6 C

Examination requirements:	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of Mechanics, Electrodynamics and special Relativity, Analysis of several real variables
Language: German, English	**Person responsible for module:** apl. Prof. Folkert Müller-Hoissen
Course frequency: Two-year as required / Winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 60	

Georg-August-Universität Göttingen **Module B.Phy.5525: Seminar on Integrable Systems and Solitons**	4 C 2 WLH

Learning outcome, core skills: **Learning outcome:** Special topics of the mathematics and physics of integrable systems and solitons, using original articles or advanced text books. **Core skills:** Ability to get acquainted with an advanced topic from this area of mathematics and physics, using original articles or advanced text book material, and to present a professional talk about this material.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Seminar	

Examination: Presentation with discussion (approx. 75 minutes) and written elaboration (max. 10 pages) **Examination prerequisites:** Active participation	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of the mathematics and physics of integrable systems and solitons.
Language: German, English	**Person responsible for module:** apl. Prof. Folkert Müller-Hoissen
Course frequency: every 4th semester; Two-year as required / Summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 10	

Georg-August-Universität Göttingen Module B.Phy.5530: Introduction to Cosmology	3 C 2 WLH
Learning outcome, core skills: Learning outcome: Newtonian cosmology, relativistic homogeneous isotropic cosmology, horizons and distances, the hot universe, Newtonian inhomogeneous cosmology, inflation. This course will be based on video lectures and short quizzes that will be discussed in class. Core skills: Understanding the evolution of the universe on very large scales, knowledge of current questions in physical cosmology.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Introduction to Cosmology (Lecture) *Course frequency:* jedes Sommersemester	2 WLH
Examination: written (120 Min.) or oral exam (ca. 30 Min.) **Examination prerequisites:** keine **Examination requirements:** Physikalisches Verständnis der Entwicklung des Universums auf sehr großen Skalen, Kenntnis der aktuellen Fragen der Kosmologie	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Jens Niemeyer
Course frequency: every 4th semester; vorraussichtlich SoSe	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** from 5
Maximum number of students: 20	

Additional notes and regulations:
Study Foci: AG, KT

Georg-August-Universität Göttingen **Module B.Phy.5531: Origin of solar systems**	3 C 2 WLH
Learning outcome, core skills: After finishing the module the students should be able to apply the fundamental knowledge about the structure and the formation of planetary systems to geophysical and astrophysical problems.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Theory and observation of early phases of stars and planetary systems, including extrasolar planets and our own solar system. In particular: Early phases of formation of stars and protoplanetary disks, models of the condensation of molecules and minerals during formation of planetary systems, chemistry and radiation in low-density astrophysical environments, formation of planets and their migration, small solar system bodies as source of information on the early solar system.	3 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Astropyhsics
Language: German, English	**Person responsible for module:** Prof. Dr. Stefan Dreizler Ansprechpartner: Dr. Jockers, Dr. Krüger
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** from 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5533: Solar and Stellar Activity**	6 C 4 WLH

Learning outcome, core skills: Fundamental knowledge of solar and stellar structure, sun-like stars, generation of magnetic fields and magnetic activity, physics of the chromosphere and corona, dynamo mechanisms, evolution of stellar activity and other stellar parameters, star-planet interaction.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture (Lecture)	

Examination: Written examination (ca. 120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Knowledge of the structure of the sun and solar-like stars; generation of magnetic fields and magnetic activity; physics of the chromosphere and the corona; dynamo mechanisms; evolution of stellar activity; star-planet interaction	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Astrophysics
Language: German, English	**Person responsible for module:** Prof. Dr. Ansgar Reiners
Course frequency: unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module B.Phy.5538: Stellar Atmospheres**	6 C 4 WLH
Learning outcome, core skills: After successful completion of the modul students should know how to applicate physical concepts (such as atomic and molecular physics, thermodynamics, and statistical physics) in an astrophysical context, and know their implementation in numerical simulations.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Physics of stellar atmospheres (Vorlesung)** **2. Stellar atmosphere modelling (Computerpraktikum)**	 2 WLH 2 WLH
Examination: Oral Exam (ca. 30 Min.)	6 C
Examination requirements: Oral account of the context and concepts learned during the two courses on the topics of interaction of radiation and matter; radiative transfer; structure of stellar atmospheres; and theoretical foundations of spectral analysis; answering of specific questions on all the aspects in this field.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Dreizler
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 20	
Additional notes and regulations: Schwerpunkt: Astro-/Geophysik	

Georg-August-Universität Göttingen **Module B.Phy.5539: Physics of Stellar Atmospheres**	3 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should understand the interaction of radiation and matter, radiative transfer, structure of stellar atmospheres; thorough understand the theoretical foundations of spectral analysis and know how to applicate physical concepts (such as atomic and molecular physics, thermodynamics, and statistical physics) in an astrophysical context.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Physics of stellar atmospheres (Vorlesung)	
Examination: Oral Exam (ca. 30 Min.)	3 C
Examination requirements: Oral account of the context and concepts of radiative transfer and structure of stellar atmospheres.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Dreizler
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 20	

Additional notes and regulations: Schwerpunkt: Astro-/Geophysik

Georg-August-Universität Göttingen **Module B.Phy.5540: Introduction to Cosmology**	3 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should understand the evolution of the universe on very large scales, knowledge of current questions in physical cosmology.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture Introduction to Cosmology	
Examination: written (120 min.) or oral (ca. 30 min.) exam **Examination requirements:** Key concepts and calculations from homogeneous cosmology: Newtonian cosmology; relativistic homogeneous isotropic cosmology; horizons and distances; the hot universe; Newtonian inhomogeneous cosmology; inflation. This course will be based on video lectures and short quizzes that will be discussed in class.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Jens Niemeyer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 3
Maximum number of students: 20	
Additional notes and regulations: Schwerpunkt: Astro-/Geophysik; Kern-/Teilchenphysik	

Georg-August-Universität Göttingen **Module B.Phy.5543: Black Holes**	3 C 2 WLH

Learning outcome, core skills: After successfully completing the module, students are expected to understand the basic mathematical properties of black holes as solutions of Einstein's equations of General Relativity and to know the scenarios of astrophysical black hole formation.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Black Holes (Lecture)	

Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Gravitational collapse, Schwarzschild black holes, charged black holes, rotating black holes, horizon properties, black hole mechanics, black hole thermodynamics	3 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of General Relativity
Language: German, English	**Person responsible for module:** Prof. Dr. Jens Niemeyer
Course frequency: at irregular intervals	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5544: Introduction to Turbulence**	3 C 2 WLH
Learning outcome, core skills: **Learning objectives:** In this course, the students will be introduced to the phenomenon of turbulence as a complex system that can be treated with methods from non-equilibrium statistical mechanics. The necessary statistical tools will be introduced and applied to obtain classical and recent results from turbulence theory. Furthermore, current numerical and experimental techniques will be discussed. **Competencies:** The students shall gain a fundamental understanding of turbulent flows as a problem of non-equilibrium statistical mechanics. Part of the course will be held in tutorial style in which textbook problems will be discussed in detail. The course shall also strengthen the students' ability to perform interdisciplinary work by stressing the interdisciplinary aspects of the field with connections to pure and applied math as well as engineering sciences.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Introduction to Turbulence (Lecture)	
Examination: Written exam (90 min.) or oral exam (approx. 30 min.) **Examination requirements:** Basic knowledge and understanding of the material covered in the course such as: continuum description of fluids (Navier-Stokes equations), non-dimensionalization & dimensional analysis, Kolmogorov phenomenology, intermittency, exact statistical approaches & the closure problem, soluble models of turbulence.	3 C

Admission requirements: none	**Recommended previous knowledge:** Basic Knowledge in continuum mechanics or electrodynamics
Language: English, German	**Person responsible for module:** Prof. Dr. Eberhard Bodenschatz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.Phy.5604: Foundations of Nonequilibrium Statistical Physics**	3 C 2 WLH

Learning outcome, core skills: **Lernziele**: Invariant densities of phase-space flows with local and global conservation of phase-space volume; reduction of a microscopic dynamics to a stochastic description, to kinetic theory and to hydrodynamic transport equations; fluctuation theorems; Green-Kubo relations; local equilibrium; entropy balance and entropy production; the second law; statistical physics of equilibrium processes as a limit of a non-equilibrium processes; applications in nanotechnology and biology: small systems far from thermodynamic equilibrium. **Kompetenzen**: After successful completion of the modul the students should know modeling approaches for a statistical-physics description of small systems far from thermodynamic equilibrium: in homework problems, that will be presented in a subsequent symposium, this will be highlighted by explicitly working out examples in nanotechnology and biology.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: lecture	

Examination: Presentation (approx. 30 min) and handout (max. 4 pages)	3 C

Examination requirements: Modeling of an experimental system by a Master equation, kinetic theory or Non-Equilibrium Molecular Dyanamics with discussion of the appropriate fluctuation relations and/or the relation of models on different levels of coarse graining.	

Admission requirements: none	**Recommended previous knowledge:** Statistische Physik
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5605: Computational Neuroscience: Basics**	3 C 2 WLH

Learning outcome, core skills: **Goals:** Introduction to the different fields of Computational Neuroscience: • Models of single neurons, • Small networks, • Implementation of all simple as well as more complex numerical computations with few neurons. • Aspects of sensory signal processing (neurons as ‚filters'), • Development of topographic maps of sensory modalities (e.g. visual, auditory) in the brain, • First models of brain development, • Basics of adaptivity and learning, • Basic models of cognitive processing. **Kompetenzen/Competences:** On completion the students will have gained… • …overview over the different sub-fields of Computational Neuroscience; • …first insights and comprehension of the complexity of brain function ranging across all sub-fields; • …knowledge of the interrelations between mathematical/modelling methods and the to-be-modelled substrate (synapse, neuron, network, etc.); • …access to the different possible model level in Computational Neuroscience.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Vorlesung	

Examination: Written examination (45 minutes) **Examination requirements:** Actual examination requirements: Having gained overview across the different sub-fields of Computational Neuroscience; Having acquired first insights into the complexity of across the whole bandwidth of brain function; Having learned the interrelations between mathematical/modelling methods and the to-be-modelled substrate (synapse, neuron, network, etc.) Being able to realize different level of modelling in Computational Neuroscience.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Florentin Andreas Wörgötter
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 2 - 6; Master: 1 - 4

Georg-August-Universität Göttingen **Module B.Phy.5606: Mechanics of the cell**	3 C 2 WLH
Learning outcome, core skills: After successfully finishing this course, students will be familiar with fundamental concepts of cellular mechanics and will be able to apply them independently to specific questions.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture	
Examination: oral exam (ca. 15 min.) or written exam (60 Min.) **Examination requirements:** Polymer physics and polymer networks, membranes, physics on small scales, cell mechanics, molecular motors, cell motility, dynamics in the cell	3 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Biophysics and/or Physics of Complex Systems
Language: English, German	**Person responsible for module:** Prof. Dr. Sarah Köster
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5607: Mechanics and dynamics of the cytoskeleton**	4 C 2 WLH

Learning outcome, core skills: After successfully finishing this course, students will be able to work on specific questions with the help of book chapters or journal publications and to present the topic in a seminar talk.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Seminar	

Examination: Presentation with discussion (Bachelor approx. 30 min., Master approx. 60 min.) **Examination prerequisites:** Active participation **Examination requirements:** Polymer physics and polymer networks; membranes; physics on small scales; cell mechanics; molecular motors; cell motility; dynamics in the cell.	4 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Biophysics and/or Physics of Complex Systems
Language: German, English	**Person responsible for module:** Prof. Dr. Sarah Köster
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 14	

Georg-August-Universität Göttingen Module B.Phy.5608: Micro- and Nanofluidics	3 C 2 WLH
Learning outcome, core skills: After successfully finishing this course, students will be familiar with basic hydrodynamics and their applications in biology, biophysics, material sciences and biotechnology. They should know the fundamentals of fluid dynamics on small scales and be able to apply them independently to specific questions.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture	
Examination: Oral exam (ca. 30 min.) or written exam (60 min.) **Examination requirements:** Fluid dynamics, hydrodynamics on the micro- and nanoscale and its applications in biology, biophysics, material sciences and biotechnology; wetting and capillarity; “life” at low Reynolds numbers; soft lithography; fluidics in biology and biophysics, “lab-on-a-chip” applications; Navier-Stokes-Equation	3 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Biophysics and/or Physics of Complex Systems
Language: German, English	**Person responsible for module:** Prof. Dr. Sarah Köster
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5611: Optical spectroscopy and microscopy**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome**: Physical basics of fluorescence and fluorescence spectroscopy, fluorescence anisotropy, fluorescence lifetime, fluorescence correlation spectroscopy, basics of optical microscopy, resolution limit of optical microscopy, wide field and confocal microscopy, super-resolution microscopy. **Core skills:**The students shall learn the basics and applications of advanced fluorescence spectroscopy and microscopy, including single-molecule spectroscopy and all variants of super-resolution fluorescence microscopy.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Fundamental understanding oft he physics of fluorescence and the applications of fluorescence in spectroscopy and microscopy.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5613: Physics of soft condensed matter**	6 C 4 WLH

Learning outcome, core skills: After successfully finishing this course, students will be familiar with fundamental concepts of soft condensed matter physics and will be able to apply them independently to specific questions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Lecture	3 WLH
2. Homework/Excercises	1 WLH

Examination: Written exam (120 min.) or oral exam (ca. 30 min.) **Examination prerequisites:** 50% of problem sets (homework) have to be solved **Examination requirements:** Intermolecular interactions; phase transitions; interface physics; amphiphilic molecules; colloids; polymers; polymer networks; gels; fluid dynamics; self-organization.	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to…Biophysics or/and Physics of complex systems or/and Solid State Physics or/and Materials Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Sarah Köster
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5614: Proseminar Computational Neuroscience**	4 C 2 WLH

Learning outcome, core skills:	**Workload:**
After successful completion of the module, students have deepened their knowledge in computational neuroscience / neuroinformatics by independent preparation of a topic. They should... - know and be able to apply methods of presentation of topics from computer science; - be able to deal with (English-language) literature; - be able to present a topic of computer science; - be able to lead a scientific discussion.	Attendance time: 28 h Self-study time: 92 h

Course: Proseminar	

Examination: Talk (approx. 45 Min.) with written report (max. 7 S.) **Examination requirements:** Proof of the acquired knowledge and skills to deal with scientific literature from the field of computational neuroscience / neuroinformatics under guidance by presentation and preparation.	4 C

Admission requirements: none	**Recommended previous knowledge:** B.Phy.5605
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 3
Maximum number of students: 14	

Georg-August-Universität Göttingen **Module B.Phy.5616: Biophysics of the cell - physics on small scales**	6 C 4 WLH
Learning outcome, core skills: After successfully finishing this course, students will be familiar with fundamental concepts of cellular biophysics and will be able to apply them independently to specific questions.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Lecture** (Lecture) **2. Homework/Excercises**	 3 WLH 1 WLH
Examination: Written exam (120 min.) or oral exam (ca. 30 min.) **Examination prerequisites:** 50% of homework/problem sets have to be solved **Examination requirements:** Physical principles in cells; adhesion; motility; cellular communication; signal transduction; biopolymers and networks; nerve cinduction; extracellular matrix; experimental methods; current research.	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Biophyiscs and/or Physics of Complex Systems
Language: German, English	**Person responsible for module:** Prof. Dr. Sarah Köster
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5620: Physics of Sports**	4 C 2 WLH
Learning outcome, core skills: After completing this module a student should be able to: • Research a topic in the scientific literature and analyse it critically. • Show fundamental skills in model building and, for example, in the discussion of nonlinear differential equations or other complex physical models.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar	
Examination: Presentation with discussion (approx. 45 minutes) and supplementary report (max. 4 pages) **Examination prerequisites:** Active participation	
Examination requirements: The student should: Present a summary of the key physics underlying a particular sport; Explain the topic from intuition to a deep description of the relevant physical facts or foundation; Set up an appropriate model and discuss the solution. Where appropriate, the student must take into account a critical discussion of the relevant literature.	

Admission requirements: none	**Recommended previous knowledge:** Basic analytical mechanics and fluid dynamics.
Language: English, German	**Person responsible for module:** Prof. Dr. Stephan Herminghaus Contact persons: Dr. O. Bäumchen, Dr. M. Mazza
Course frequency: unegular, two year as required	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.Phy.5621: Stochastic Processes**	4 C 2 WLH
Learning outcome, core skills: After successful completion of this course, students should, when asked, be able to employ the fundamental concepts of stochastic processes, that lie on the boundary between biology, physics and economics.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar	
Examination: Presentation with discussion (approx. 60 minutes) **Examination prerequisites:** Active Participation **Examination requirements:** Random walks, space-time propagation models (of information and epidemics); entropy concepts; Information theory for stochastic processes, Markov chains, Fokker-Planck formalism. The given presentation time includes time for the discussion.	
Examination requirements:	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Theo Geisel
Course frequency: every 4th semester; two-year as required, summer semester or winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5623: Theoretical Biophysics**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** Basics of probability theory, Bayes Theorem, Brownian motion, stochastic differential equations, Langevin equation, path integrals, Fokker-Planck equation, Ornstein-Uhlenbeck processes, thermophoresis, chemotaxis, Fluctuation Dissipation Theorems, Stochastic Resonance, Thermal Ratchet, motor proteins, hydrodynamics at the nanoscale, population dynamics, Jarzynski relations, non-equilibrium thermodynamics, neural networks. **Core skills:** The core coal is to teach students fundamental theoretical concepts about stochastic systems in the widest sense, an the application of these concepts the biophysics of biomolecules, cells and populations.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Vorlesung mit Selbststudium Literatur	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Derivation of fundamental relations describing stochastic systems, derivation, handling and explanation of differential equations, derivation of analytical and approximative solutions for the various considered problems.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Jörg Enderlein
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5624: Introduction to Theoretical Neuroscience**	4 C 2 WLH
Learning outcome, core skills: After successfully completing this course, students should understand and be able to employ the fundamental concepts, model representations and mathematical methods of the theoretical physics of neuronal systems.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar	
Examination: Lecture (approx. 60 minutes) **Examination prerequisites:** Active Participation **Examination requirements:** Elementary knowledge of the construction, biophysics and function of nerve cells; probabilistic analysis of sensory encoding; simple models of the dynamics and information processing in networks of biological neurons; modelling of the biophysical foundations of learning processes.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Fred Wolf
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.Phy.5628: Pattern Formation**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome**: Spatial patterns such as stripes or spots emerge in many physical systems, biology and beyond. This course will cover the mechanisms and most common examples of such patterns. We shall show how broad classes of nonlinear dynamical systems are related in terms of non-dimensional groups, and symmetries. Linear stability theory will be introduced to demonstrate the onset of emergent features, and amplitude equations will be derived around these instabilities to describe the rules of pattern selection (like spots or stripes). Finally, the significance of defects and their dynamics will be explored. Model systems such as convection cells, waves in excitable tissue, wrinkling, reaction-diffusion patterns and beyond will be introduced. Additional context and related questions of current research will be covered in talks by members of the Göttingen Research Campus. **Core skills:** After successful completion of the modul, the students should... • know, how to approach the study of natural patterns in nonlinear systems from a rigorous physical perspective; • know, how to identify the conditions for the onset of a pattern, and to analyse pattern selection and stability; • be able to develop a familiarity with the principles of pattern formation, and apply these to a broad range of situations, from the large-scale structure of the universe, to a leopard's spots and flux tubes in superconductors; • be able to perform an in-depth investigation on a particular topic of their choice, and present this topic during class.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. lecture	2 WLH
2. tutorium	2 WLH

Examination: presentation (approx. 45 min) and handout (max. 4 pages)	6 C

Examination requirements: Modeling of an experimental system by identifying appropriate dimensionless variables; determining the stability threshold; deriving appropriate amplitude equations and discussing the pattern selection beyond the threshold of linear stability.	

Admission requirements: none	**Recommended previous knowledge:** Analytical Mechanics, basic knowledge on Partial Differential Equations.
Language: English	**Person responsible for module:** apl. Prof. Dr. Jürgen Vollmer
Course frequency: two year as required, summer or winter term	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

3 times	Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 50	

Georg-August-Universität Göttingen Module B.Phy.5629: Nonlinear dynamics and time series analysis	6 C 4 WLH
Learning outcome, core skills: Sound knowledge and practical experience with methods and concepts from Nonlinear Dynamics and Time Series Analysis, mainly obtained by devising, implementing, and running algorithms and simulation programs.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Blockpraktikum	
Examination: Presentation with discussion (approx. 45 minutes) and written elaboration (max. 10 pages) **Examination requirements:** • Presentation of a specific topic • Report about own (simulation) results obtained for the specific topic	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic programming skills (for the exercises)
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Ulrich Parlitz
Course frequency: sporadic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 12	

Additional notes and regulations:
(Duration: 2 weeks with 8h per day)

Georg-August-Universität Göttingen **Module B.Phy.5631: Self-organization in physics and biology**	4 C 2 WLH
Learning outcome, core skills: **Learning outcome**: Non-linear dynamics, instabilities, basics of self-organisation, bifurcations, non-equilibrium thermodynamics: **Core skills:** Upon successful seminar participation, the students should be capable of - accomplish literature research autonomously and therefore understand and analyse scientifc articles in the corresponding scientific context - create a presentation including physical and biological basics relevant to the scientific article and give the oral presentation	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar	
Examination: Presentation (approx. 45 Min.) **Examination prerequisites:** Active Participation **Examination requirements:** Elaborated presentation, which includes an introduction to the necessary basics	

Admission requirements: none	**Recommended previous knowledge:** -Introduction to biophysics -Introduction to physics of complex systems
Language: English, German	**Person responsible for module:** Prof. Dr. Eberhard Bodenschatz Further contact person: Dr. M. Tarantola
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 10	

Georg-August-Universität Göttingen Module B.Phy.5632: Current topics in turbulence research	4 C 2 WLH
Learning outcome, core skills: **Learning outcome:** Based on a selected topic the students shall develop a basic understanding of turbulent flows. **Core skills**: The goal of this course is to enable the students to present their research in the context of the international state of the art of the field.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar	WLH
Examination: Presentation (approx. 45 Min.) **Examination prerequisites:** Active Participation **Examination requirements:** Basic understanding of turbulence; instabilities, scaling, models of turbulence, turbulence in rotating and stratified systems, turbulent heat transport, particles in turbulence	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of advanced continuum mechanics or electrodynamics.
Language: English, German	**Person responsible for module:** Prof. Dr. Eberhard Bodenschatz
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module B.Phy.5636: Introduction to Chaotic Behavior II: Hamiltionian Systems**	3 C 2 WLH
Learning outcome, core skills: On successful completion of this course, students shall have a command of the analytical methods of non-linear dynamics.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture	
Examination: Written examination (90 minutes) **Examination prerequisites:** none **Examination requirements:** Arnold’s cat map; Hartmann-Grobmann theory; homoclinic slices; Melnikov methods; homoclinic tangles; Smale’s horseshoe map; ergodicity; Kolmogrov-Sinai entropy.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Theo Geisel
Course frequency: Two year as required / summer or winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5639: Optical measurement techniques**	3 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should ... - be able to apply light models - have understood basic optical principles of measurement - have gained an overview of optical measurement method for measuring different physical quantities at different scales	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Optical Measurement Techniques (Lecture)	
Examination: Presentation with discussion (approx. 30 min.) or oral examination (approx. 30 Min.) **Examination requirements:** Understanding optical measurement principles and methods	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik / Ansprechpartner: Dr. Nobach
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5645: Nanooptics and Plasmonics**	3 C 2 WLH
Learning outcome, core skills: After the course, the students should have a profound knowledge about the rapidly evolving field nanooptics and plasmonics, both experimentally as well as theoretically.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Nanooptics and Plasmonics (Lecture)	
Examination: Written examination (90 min.) or oral examination (approx. 30 Min.) **Examination prerequisites:** keine **Examination requirements:** Electrodynamics of single particle/molecule emission, electrodynamic interaction of nano-emitters and molecules with light, interaction of light with nanoscale dielectric and plasmonic structures, and with optical metamaterials. Theory of light-matter interaction at the nanometer length scale. Fundamentals of optical microscopy and spectroscopy, applied to optical quantum emitters.	

Admission requirements: none	**Recommended previous knowledge:** Experimental Physics I-IV
Language: German, English	**Person responsible for module:** Prof. Dr. Jörg Enderlein
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5646: Climate Physics**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: This course will introduce the physical principles of the Earth's climate, and the dynamics of our atmosphere and oceans. We will show how the basic features of a climate system can be understood through a detailed energy balance. A momentum balance, in the form of the Navier-Stokes equations, and mass balance, give rise to many of the additional behaviours of a real climate system. The main features of atmospheric and ocean circulation, mixing, and transport will be discussed in this context, including such topics as the thermohaline circulation; turbulent mixing; atmospheric waves; and Coriolis effects. We will then return to the global energy budget, and discuss physically grounded models of climate prediction and climate sensitivity (e.g. Milankovitch cycles), as well as their implications. In the latter part of the course, additional context on related questions of current research will be covered in special topics presented by members of the Göttingen Research Campus. **Core skills:** After successful completion of the modul the students should ... • know how to approach the study of climate in planetary systems from a rigorous physical perspective; • know which factors influence the climate, and how to analyse climate patterns and stability; • be able to develop a familiarity with the principles of climate science, and apply these to a broad range of situations, from the large-scale convection patterns in atmospheres and oceans, to the impact of clouds and precipitation, and box models for the energy and entropy budget.	Attendance time: 56 h Self-study time: 124 h

Course: Lecture with exercises	

Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Profound geophysical basis for the work on issues of climate physics.	

Admission requirements: none	**Recommended previous knowledge:** Basics of Hydrodynamics
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Jürgen Vollmer
Course frequency: two year as required, winter term or summer term	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module B.Phy.5647: Physics of Coffee, Tea and other drinks**	4 C 2 WLH
Learning outcome, core skills: After completing this module a student should be able to: • Research a topic in the scientific literature and analyse it critically. • Show fundamental skills in model building and, for example, in the discussion of nonlinear differential equations or other complex physical models. • Understand the phase behaviour of two (or more) component mixtures, the kinetics of phase separation, the physics of multi-phase fluids and soft materials such as foams and gels.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Physics of Coffee, Tea and other drinks (Seminar)	
Examination: Presentation with discussion (approx. 45 minutes) and written elaboration (max. 4 pages) **Examination prerequisites:** Active Participation **Examination requirements:** Presentation of a complex physical summary of the key physics underlying a mixed drink, or other beverage (e.g. drainage of foam in espresso, slow waves and convective stripes in latte macchiato, bubble formation and growth in champagne). Where appropriate, the student must take into account a critical discussion of the relevant literature.	

Admission requirements: none	**Recommended previous knowledge:** Basic analytical mechanics and fluid dynamics
Language: German, English	**Person responsible for module:** Prof. Dr. Stephan Herminghaus Contact Person: Dr. M. Mazza
Course frequency: unregular, two year as required	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.Phy.5648: Theoretical and Computational Biophysics**	3 C 2 WLH
Learning outcome, core skills: This combined lecture and hands-on computer tutorial focuses on the basics of computational biophysics and deals with questions like "How can the particle dynamics of thousands of atoms be described precisely?" or "How does a sequence alignment algorithm function?" The aim of the lecture is to develop a physical understanding of those "nano maschines" by using modern concepts of non-equilibrium thermodynamics and computer simulations of the dynamics on an atomistic scale. Moreover, the lecture shows (by means of examples) how computers can be used in modern biophysics, e.g. to simulate the dynamics of biomolecular systems or to calculate or refine a protein structure. No cell could live without the highly specialized macromolecules. Proteins enable virtually all tasks in our bodies, e.g. photosynthesis, motion, signal transmission and information processing, transport, sensor system, and detection. The perfection of proteins had already been highly developed two billion years ago.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Theoretical and Computational Biophysics (Lecture, Exercise)	
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** none **Examination requirements:** Protein structure and function, physics of protein dynamics, relevant intermolecular interactions, principles of molecular dynamics simulations, numeric integration, influence of approximations, efficient algorithms, parallel programing, methods of electrostatics, protonation balances, influence of solvents, protein structure determination (NMR, X-ray), principal component analysis, normal mode analysis, functional mechanisms in proteins, bioinformatics: sequence comparison, protein structure prediction, homology modeling, and hands-on computer simulation.	

Admission requirements: none	**Recommended previous knowledge:** • Introduction to Biophysics • Introduction to Physics of Complex Systems
Language: English, German	**Person responsible for module:** Hon.-Prof. Dr. Karl Helmut Grubmüller
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module B.Phy.5651: Advanced Computational Neuroscience I	3 C 2 WLH
Learning outcome, core skills: Participants in the course can explain and relate biological foundations and mathematical modelling of selected (neuronal) algorithms for learning and pattern formation. Based on the the algorithms' properties, they can discuss and derive possible technical applications (robots).	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Vorlesung (Lecture)	
Examination: Written examination (90 Min.) or oral examination (approx. 20 Min.) **Examination requirements:** Algorithms for learning: - Unsupervised Learning (Hebb, Differential Hebb), - Reinforcement Learning, - Supervised Learning Algorithms for pattern formation. Biological motivation and technical Application (robots).	3 C

Admission requirements: none	**Recommended previous knowledge:** Basics Computational Neuroscience
Language: English	**Person responsible for module:** Prof. Dr. Florentin Andreas Wörgötter
Course frequency: each winter semester1	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 50	

Additional notes and regulations:

Hinweis: Die B.Phy.5652 kann als vorlesungsbegleitendes

Praktikum besucht werden.

Georg-August-Universität Göttingen **Module B.Phy.5652: Advanced Computational Neuroscience II**	3 C 2 WLH
Learning outcome, core skills: Participants in the course can implement, test, and evaluate the properties of selected (neuronal) algorithms for learning and pattern formation.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Praktikum	
Examination: 4 Protocols (max. 3 Pages) and Presentations (ca. 10 Min.), not graded, not graded **Examination requirements:** Algorithms for learning: - Unsupervised Learning (Hebb, Differential Hebb), - Reinforcement Learning, - Supervised Learning Algorithms for pattern formation. Biological motivation and technical Application (robots). *For each of the 4 programming assignments 1 protocol (ca. 3 pages) and 1 oral presentations (demonstration and discussion of the program, ca. 10 min).*	3 C

Admission requirements: B.Phy.5651 (can be taken in parallel to B.Phy.5652)	**Recommended previous knowledge:** Programming in C++, basic numerical algorithms, Grundlagen Computational Neuroscience B.Phy.5504: Computational Physics (Scientific Computing)
Language: English	**Person responsible for module:** Prof. Dr. Florentin Andreas Wörgötter
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module B.Phy.5656: Experimental work at large scale facilities for X-ray photons**	3 C 3 WLH
Learning outcome, core skills: The goal of this course is to acquire the competence to perform experiments at modern synchrotron sources and free-electron-laser sources (large scale facilities) in a team; this includes the theoretical and experimental preparation of such beam times, as well as the experiment itself and the data analysis; Competences: after successfully finishing this course, students should have the theoretical basis as well as the experimental abilities for performing modern X-ray experiments and should have applied their knowledge to specific examples from biophysics, soft matter physics and materials physics.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Lab Course *Contents*: Lab course during an x-ray beam time performed by the Institute for X-Ray Physics at a national or international source (in particular DESY, BESSY, XFEL, ESRF, SLS, NSLSII, SACLA, Diamond, Soleil, Elettra); students will already be involved in the preparation and will thus be well prepared for the experimental approach. At the x-ray source, they experience the technical/experimental as well as the theoretical part of the work; after the campaign, they learn modern methods of data analysis by direct interaction with the project leaders.	
Examination: Written report (max. 10 p.) or oral examination (approx. 30 min.) about the finished scientific project **Examination prerequisites:** Active participation at an X-ray beam time, including preparation and post-processing **Examination requirements:** Description of the scientific project, including the theoretical background and the experimental challenges and approaches; description of the data analysis and the results; discussion within the scientific context.	3 C

Admission requirements: none	**Recommended previous knowledge:** Good basic knowledge of physics (semesters 1-4) and good or very good knowledge of biophysics and x-ray optics
Language: German, English	**Person responsible for module:** Prof. Dr. Sarah Köster Prof. Dr. Tim Salditt
Course frequency: each semester; every semester, depending of availability of X-ray beam times	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4

Additional notes and regulations: Maximum number of students: 2/beam time; if there are more applicants than slots, participants will be selected according to their experience and knowledge

Georg-August-Universität Göttingen **Module B.Phy.5657: Biophysics of gene regulation**	3 C 2 WLH

Learning outcome, core skills: **Objectives:** The students will learn basic concepts of the biophysics of gene regulation, including physical mechanisms and their physiological functions, as well as the methods for the theoretical analysis of such systems and their dynamics. **Competences:** After successful participation in the module, students should be able to analyze problems in gene regulation using the theoretical tools discussed in the lecture.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Biophysics of gene regulation (Lecture) *Course frequency:* jedes Wintersemester	WLH

Examination: written examination (60 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Physical principles of gene regulation, mechanisms of regulation, thermodynamic modelling, deterministic and stochastic dynamics	3 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in statistical physics and biophysics
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Klumpp
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5658: Statistical Biophysics**	6 C 4 WLH

Learning outcome, core skills: **Objectives:** The students will learn basic concepts of statistical biophysics at the molecular, cellular and population level, as well as methods for the theoretical analysis of biophysical systems. **Competences:** After successful participation in the module, students should have working knowledge of basic concepts of statistical biophysics and be able to apply them to selected problems.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Statistical Biophysics (Lecture with integrated problem sessions) *Course frequency:* jedes Wintersemester	WLH

Examination: written examination (120 Min.) or oral examination (approx. 30 Min.) **Examination requirements:** Physical principles of biological systems on the molecular, cellular and population level, application of methods from statistical physics to biological and biophysical problems.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in biophysics and statistical physics
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Klumpp
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5659: Seminar on current topics in theoretical biophysics**	4 C 2 WLH
Learning outcome, core skills: **Objectives:** The students will develop a basic understanding of current topics and methods of theoretical biophysics at the molecular, cellular and population level, based on selected examples. **Competences:** After completing this module, the students should be able to research a topic in theoretical biophysics in the scientific literature, analyse it critically and present it in a seminar talk.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar on current topics in theoretical biophysics	
Examination: Presentation with discussion (Bachelor approx. 30 min., Master approx. 60 min.) **Examination prerequisites:** Active participation **Examination requirements:** Presentation of a selected research topic and critical discussion of its methods and results	4 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in biophysics and statistical physics
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Klumpp
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Additional notes and regulations:	

Georg-August-Universität Göttingen **Module B.Phy.5660: Theoretical Biofluid Mechanics**	3 C 2 WLH

Learning outcome, core skills: **Learning objectives:** The course will discuss the theoretical foundations of fluid mechanics used in the study of biological systems. Important concepts in the mathematical study of fluids will be introduced and employed to investigate blood flow and circulation, the propulsion of organisms and transport facilitated by fluid flow. **Competencies:** Students will learn to set up theoretical models for a range of biological systems involving fluids employing the Navier-Stokes equation and appropriate boundary conditions. The course will prepare the students to simplify, assess and analyze models to investigate the intricate role of fluids in biological settings.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Theoretical Biofluid Mechanics (Lecture)	

Examination: Written (60 minutes) or oral exam (30 minutes) **Examination prerequisites:** None **Examination requirements:** Solving Navier-Stokes equation in simple geometry, derive simplified equations from models of fluid flow and transport, explore theoretical models in limiting parameter range and assess prediction in relation to modeled biological system. The exam will be oral, if max. 20 students take part at the first date of the course. Oherwise it will be a written exam.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of calculus and algebra
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Klumpp Contact: Karin Alim
Course frequency: every 4th semester; Every second Summerterm in Rotation to Microfluidic	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 3 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5661: Biomedical Techniques in Complex Systems**	4 C 2 WLH
Learning outcome, core skills: **Learning objectives:** The seminar provides an overview of current biomedical techniques applied in research and therapy. A strong orientation towards the combination of theoretical basics and practical use will be given by introducing up-to-date research results (original articles and text book material). **Competencies**: Besides getting a deeper understanding of current biomedical techniques, the students will learn how to prepare and present up-to-date scientific results. This includes literature research, understanding of underlying methodological basics and didactic preperation (talk in front of the seminar participants).	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Biomedical Techniques in Complex Systems (Seminar)	
Examination: Oral examination, (Bachelor: ca 30 min.; Master: ca. 45 min.) **Examination prerequisites:** none **Examination requirements:** The students will elaborate and give a presentation about current biomedical techniques. The talk should include an introductory part to the underlying basics.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Luther
Course frequency: each winter semester1	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Contact: Dr. C. Richter

Georg-August-Universität Göttingen **Module B.Phy.5662: Active Soft Matter**	4 C 2 WLH
Learning outcome, core skills: Students acquire in depth expertise in the discipline of Active Soft Matter, focussed on artificial and biological microswimmers in experiment and theory. Topics include self-propulsion at low Reynolds numbers, chemo-, electro-, magneto- , gravi- and phototaxis, active droplets, colloids and Janus particles, dynamics of flagellae and ciliae in bacteria and algae, interaction with interfaces and complex geometries, collective and swarming dynamics and active emulsions. Core skills include the independent study of literature on current research, and the condensation, presentation and discussion of a specific topic, which are vital skills pertaining to presenting your own research and its position in a wider research field. Students will practice the critical appreciation of current research in scientific discussion and receive feedback on their presentation skills.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Active Soft Matter (Seminar)	
Examination: Oral seminar presentation (ca. 45 min.) and handout (4 pages max.) **Examination prerequisites:** none **Examination requirements:** Preparation, presentation and discussion of a current topic in active soft matter based on published literature. Active engagement in discussions on other student's presentations. Handouts must be submitted before the presentation.	

Admission requirements: none	**Recommended previous knowledge:** introductory hydrodynamics and thermodynamics
Language: English, German	**Person responsible for module:** Prof. Dr. Stephan Herminghaus
Course frequency: every 3rd semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 26	

Additional notes and regulations:
Contact: Dr. Oliver Bäumchen, Dr. Corinna Maaß,

Georg-August-Universität Göttingen Module B.Phy.5709: Seminar on Nanoscience	4 C 2 WLH
Learning outcome, core skills: **Lernziele**: Electronic properties of electrons confined in low-dimensional structures (2D, 1D and 0D). Experimental methods for the preparation and characterization of nanostrucures. Functional nanostructures. Devices in nanoelectronics. Semiconductor materials will be on focus. **Kompetenzen**: After successful completion of the modul the students should be able to gain a deep knowledge of a current topic in nanoscience and nanodevices from the recommended scientific literature. The student will present and discuss the topic in a Seminar.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar (Blockveranstaltung)	
Examination: Vortrag (ca. 30 Min.) - student choice if in German or in English **Examination prerequisites:** Aktive Teilnahme	
Examination requirements: The students should achieve a deep knowledge of a current topic in nanoscience and nanodevices from the recommended scientific literature; the student should be able to transfer this knowledge to an audience in a seminar.	

Admission requirements: none	**Recommended previous knowledge:** • Einführung in die Festkörperphysik • Einführung in die Materialphysik • Quantenmechanik I • Nanoscience
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 2
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5714: Introduction to Solid State Theory**	6 C 6 WLH
Learning outcome, core skills: **Lernziele:** Fundamental concepts of of solid state theory, Born-Oppenheimer approximation, homogeneous electron gas, electrons in lattices, lattice vibrations, elementary transport theory **Kompetenzen:** After successful completion of the modul students should be able to describe and calculate fundamental properties of solids; understand and use the language of solid-state theory.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Courses: **1. lecture** **2. exercises**	 4 WLH 2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Application of fundamental concepts in solid state theory, interpretation of basic experimental observations, theoretical description of fundamental phenomena in solid state physics.	6 C

Admission requirements: keine	**Recommended previous knowledge:** Quantum mechanics I
Language: German, English	**Person responsible for module:** Prof. Dr. Thomas Pruschke Prof. Kehrein
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5716: Nano-Optics meets Strong-Field Physics**	6 C 4 WLH

Learning outcome, core skills: At the end of the course, students should understand and be able to apply the basic concepts of nano-optics and strong-field physics, as well as their connection in modern research. In the accompanying exercises, numerical simulations will be developed which build on the topics discussed in the lectures. An introduction will be given to scripting in Matlab and to finite element simulations with Comsol Multiphysics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Vorlesung	2 WLH
2. Übung	2 WLH

Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Implementation of a task in an executable programme.	6 C

Admission requirements: none	**Recommended previous knowledge:** Experimentalphysik I-IV, Quantenmechanik
Language: German, English	**Person responsible for module:** Prof. Dr. Claus Ropers StudiendekanIn der Fakultät für Physik
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.Phy.5717: Mechanisms and Materials for Renewable Energy**	6 C 4 WLH

Learning outcome, core skills: By participation in both lectures on photovoltaics and solar thermal energy, thermoelectrics and solar fuels students gain knowledge about the full spectrum of physical and chemical basics of renewable energy conversion. In addition, overlapping aspects of fundamental concepts and technological approaches have been reviewed. Students shall independently apply gained knowledge to acquire and present current research in the field.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Mechanismen und Materialien für erneuerbare Energien (Lecture)	

Examination: Poster presentation with oral examination (approx. 30 Min.) **Examination requirements:** Beherrschung der grundlegenden Begriffe, Fakten und Methoden. Selbständige Erarbeitung wissenschaftlicher Publikationen und deren Präsentation.	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to solid state physics, Introduction to materials physics
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Michael Seibt Prof. Dr. Christian Jooß
Course frequency: two-year as required, summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5718: Mechanisms and Materials for Renewable Energy: Photovoltaics**	4 C 2 WLH

Learning outcome, core skills: After successful completion of this module students are familiar with physical basics or photo-electric energy conversion, are able to apply fundamental concepts and gained knowledge about important materials systems of photovoltaics. In addition, important experimental methods as well as current and future technological concepts have been reviewed. Students shall independently apply gained knowledge to acquire and present current research in the field.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Mechanismen und Materialien für erneuerbare Energien: Photovoltaik (Lecture)	

Examination: Poster presentation with oral examination (approx. 30 Min.) **Examination requirements:** Beherrschung der grundlegenden Begriffe, Fakten und Methoden. Selbständige Erarbeitung wissenschaftlicher Publikationen und deren Präsentation.	4 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to solid state physics, Introduction to Materials physics
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Michael Seibt
Course frequency: zweijährig im SoSe	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5719: Mechanisms and Materials for Renewable Energy: Solar heat, Thermoelectric, solar fuel**	4 C 2 WLH

Learning outcome, core skills: Physical and chemical basics of light and heat conversion to electrical and chemical energy. In particular:Mechanisms of solarthermic, thermoelectric, elctro- and photochemical energy conversion. Important model systems and materials. Outlook in current research activities. Students shall independently apply gained knowledge to acquire and present current research on relevant systems.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Mechanismen und Materialien für erneuerbare Energien: Solarthermie, Thermoelektrik, solarer Treibstoff (Lecture)	

Examination: Posterpresentation with oral examination (approx. 30 Min.) **Examination requirements:** Beherrschung der grundlegenden Begriffe, Fakten und Methoden. Selbständige Erarbeitung wissenschaftlicher Publikationen und deren Präsentation.	4 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to solid state physics, Introduction to Materials Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Christian Jooß
Course frequency: two-year as required, summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5804: Quantum mechanics II**	6 C 6 WLH

Learning outcome, core skills: **Acquisition of knowledge:** Scattering theory; Symmetries in QM, especially angular momentum and spin; Many particle systems and Fock formalism; Quantization of the electromagnetic field; Relativistic QM: Klein-Gordon equation and Dirac equation in external fields. **Competencies:** The students shall be familiar with advanced concepts of Quantum Mechanics. They can apply them to explicit examples.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Courses:	
1. Quantum mechanics II (Lecture)	4 WLH
2. Quantum mechanics II (Exercise)	2 WLH

Examination: Written examination (120 minutes) **Examination requirements:** Solution of concrete problems treated in the lecture course. Explanation of notions and methods of advanced QM.	6 C

Admission requirements: none	**Recommended previous knowledge:** Quantum mechanics I, Classical field theory
Language: English	**Person responsible for module:** apl. Prof. Dr. Karl-Henning Rehren
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 3
Maximum number of students: 80	

Georg-August-Universität Göttingen Module B.Phy.5805: Quantum field theory I	6 C 6 WLH
Learning outcome, core skills: **Acquisition of knowledge:** Quantization of free relativistic wave equations (Klein-Gordon and Dirac); General properties of quantum fields; Interaction with external sources; Perturbation theory and basics of renormalization theory; Quantum Electro Dynamics and abelian gauge symmetry. **Competencies:** The students shall be familiar with the basic concepts and methods of Quantum Field Theory. They can apply them to explicit examples.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Courses:	
1. Quantum field theory I (Lecture)	4 WLH
2. Quantum field theory I (Exercise)	2 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Solution of concrete problems treated in the lecture course. Explanation of notions and methods of Quantum Field Theory.	6 C

Admission requirements: none	**Recommended previous knowledge:** Quantum mechanics I, II, Classical Field theory
Language: English	**Person responsible for module:** apl. Prof. Dr. Karl-Henning Rehren
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 2
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module B.Phy.5807: Physics of particle accelerators**	3 C 3 WLH

Learning outcome, core skills: After successful completion of this module, students should be familiar with the concepts, the physics (mainly electromagnetism) and explicit examples of historic and modern particle accelerators. Ideally, they should be able to simulate beam optics via numerical simulations (MatLab/SciLab).	**Workload:** Attendance time: 42 h Self-study time: 48 h

Course: Physics of particle accelerator (Lecture)	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Introduction to physics of particle accelerators; synchrotron radiation; linear beam optics; injection and ejection; high-frequency system for particle acceleration; radiation effects; luminosity, wigglers and undulators; modern particle accelerators based on the examples HERA, LEP, Tevatron, LHC, ILC and free electron laser FLASH/XFEL.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: every 4th semester; unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5808: Interactions between radiation and matter - detector physics**	3 C 3 WLH
Learning outcome, core skills: After successful completion of this module, students should be familiar with a conceptional understanding of different particle detectors and the underlying interactions. They should be familiar with physics processes of particle or radiation detection in high energy physics and related fields and applications.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Interactions between radiation and matter - detector physics (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Mechanism of particle detection; interactions of charged particles and photons with matter; proportional and drift chambers; semiconductor detectors; microstrip and pixel detectors; Cherenkov detectors; transition radiation detectors; scintillation (organic crystals and plastic scintillators); electromagnetic calorimeter; hadron calorimeter.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.Phy.5809: Hadron-Collider-Physics**	3 C 3 WLH

Learning outcome, core skills: Learning Objectives and Competencies: After successful completion of this module, students should be well-versed in the challenges and concepts of experimental physics at modern hadron colliders.	**Workload:** Attendance time: 42 h Self-study time: 48 h

Course: Hadron-Collider-Physics (Lecture)	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Introduction to particle physics; Kinematics at hadron colliders; historical overview and experimental features of hadron colliders such as PS, SPS, Tevatron, HERA, and LHC; Typical detectors and their functionalities for hadron collider physics; Structure of the proton and measurements thereof; Factorization theorem; Total and differential hadron cross sections; Diffraction; Soft underlying event, multiple interactions, and pile-up; QCD and Jet Physics; Angular correlations; Physics of vector bosons; Z-Asymmetry and W mass measurements; W charge asymmetry; W/Z cross sections; Physics of the top quark; Search for supersymmetric particles as candidates of dark matter; Searches for new physics in exotic models; Experimental methods for data analysis.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear and Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: every 4th semester; irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5810: Physics of the Higgs boson**	3 C 3 WLH
Learning outcome, core skills: After successful completion of this module, students should possess a deep understanding of the Higgs mechanism, the properties of the Higgs boson, and experimental methods (concepts and concrete examples) used in investigations of the Higgs sector.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Physics of the Higgs boson (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Review of the Standard Model of particle physics; The Higgs mechanism and the Higgs potential; properties of the Standard Model Higgs boson; Experimental methods in the search for the Higgs boson at LEP, Tevatron and LHC; Discovery of the Higgs boson; Measurement of the Higgs boson couplings and other properties; Two Higgs Doublet Modells and extended Higgs sectors (in particular, the MSSM); Searches for Higgs bosons beyond the Standard Model.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: every 4th semester; irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5811: Statistical methods in data analysis**	3 C 3 WLH
Learning outcome, core skills: After successful completion of this module, students should be well-versed in the theoretical foundations of statistical methodology used in data analysis. This is complemented with concrete examples where statistical analysis is performed using the ROOT software package (a free C++ type software package for data analysis, which runs on Linux, Windows, and Mac operating systems).	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Statistische Methoden der Datenanalyse (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Concepts, methods, can concrete examples of statistical methods in data analysis: Introduction and description of data; theoretical probability density functions, including Gaussian, Poisson, and multi-dimensional distributions; parameter estimation; maximum likelihood method (and examples); chi^2 method and chi^2-distribution; optimization; hypothesis tests; classification methods; Monte Carlo methods; unfolding.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module B.Phy.5812: Physics of the top-quark	3 C 3 WLH
Learning outcome, core skills: Learning Objectives and Competencies: After successful completion of this module, students should be familiar with the properties and interactions of the top-quark as well as the experimental methods for its studies.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Physics of the top-quark (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Concepts and specific experimental methods for the discovery and studies of the top-quark. Introduction to particle physics of quarks, discovery of the top-quark, top-antitop production (theory and experiment); electroweak production of single-top quarks; top-quark mass; electric charge and spin of top-quarks; W-helicity in top-quark decay; top-quark decay in the standard modell and beyond; sensitivity to new physics; top-quark physics at the ILC, recent results of top-quark physics.	

Admission requirements: keine	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: every 4th semester; irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 5 - 6; Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.Phy.5901: Advanced Algorithms for Computational Physics**	6 C 4 WLH
Learning outcome, core skills: The goal of the module is to introduce advanced algorithms and program structures / design, enabling the students to write codes for more advanced tasks in computational physics from scratch (preferably in C++).	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Vorlesung und Übung	
Examination: Oral exam (approx.30 min.) or oral presentation with discussion (approx.30 min.), 2 weeks time for preparation) or project work at home with a final report (max. 15 pages) **Examination prerequisites:** none **Examination requirements:** • Implementation and usage of advanced algorithms to solve problems in computational physics • Understanding of the algorithms • Ability to choose suitable methods for solving a given problem Topics: 1. „Design Patterns“: typical programming/design structures and strategies 2. Algorithms for quantum problems, e.g., exact diagonalization approaches, numerical renormalization group and related methods, Quantum Monte Carlo 3. Algorithms used in engineering, e.g., finite element methods 4. Algorithms for and basics of computational finance	6 C

Admission requirements: none	**Recommended previous knowledge:** Programming course, course lecture „CWR“
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 6; Master: 1 - 4
Maximum number of students: 40	

Additional notes and regulations:

Georg-August-Universität Göttingen **Module B.Phy.606: Electronic Lab Course for Natural Scientists**	6 C 6 WLH

Learning outcome, core skills: Learning Objectives and Competencies: After successful completion of this module, students should be familiar with • fundamental concepts and terminology of electronics • be able to handle modern electronic devices (simple devices, basic circuits) • be able to work out and conduct a scientific project within a given time window	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: B.Phy.606. Electronic lab course for natural scientists (Internship, Lecture, Exercise) 1. Vorlesung mit Übung 2. Praktikum (5 Versuche) 3. Praktikum (1 Projekt)	
Examination: Presentation with discussion (approx. 30 minutes) and written elaboration (max. 10 pages) **Examination prerequisites:** At least 50% of problem sets (homework) have to be solved (passed) **Examination requirements:** 1. fundamental concepts and terminology of electronics, 2. handling of simple electronics devices, basic circuits and functional units; 3. conceptual design and realisation of projects in electronics.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 20	

Additional notes and regulations: Block course

Georg-August-Universität Göttingen Module B.Phy.7601(Bio): Computational Neuroscience: Basics	4 C 2 WLH
Learning outcome, core skills: **Goals:** Introduction to the different fields of Computational Neuroscience: • Models of single neurons, • Small networks, • Implementation of all simple as well as more complex numerical computations with few neurons. • Aspects of sensory signal processing (neurons as ‚filters'), • Development of topographic maps of sensory modalities (e.g. visual, auditory) in the brain, • First models of brain development, • Basics of adaptivity and learning, • Basic models of cognitive processing. **Kompetenzen/Competences:** On completion the students will have gained… • …overview over the different sub-fields of Computational Neuroscience; • …first insights and comprehension of the complexity of brain function ranging across all sub-fields; • …knowledge of the interrelations between mathematical/modelling methods and the to-be-modelled substrate (synapse, neuron, network, etc.); • …access to the different possible model level in Computational Neuroscience.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Vorlesung	
Examination: Written examination (45 minutes) **Examination requirements:** Actual examination requirements: Having gained overview across the different sub-fields of Computational Neuroscience; Having acquired first insights into the complexity of across the whole bandwidth of brain function; Having learned the interrelations between mathematical/modelling methods and the to-be-modelled substrate (synapse, neuron, network, etc.) Being able to realize different level of modelling in Computational Neuroscience.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Florentin Andreas Wörgötter
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 2 - 6; Master: 1 - 4

Georg-August-Universität Göttingen **Module B.SK-Phy.9001: Papers, Proposals, Presentations: Skills of Scientific Communication**	4 C 2 WLH
Learning outcome, core skills: Goals: Handling of different presentation media (written and oral); presenting complex facts to experts and laymen; skills of communication and scientific discussion	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Papers, Proposals, Presentations: Skills of Scientific Communication (Seminar)	2 WLH
Examination: Lecture (approx. 30 minutes) **Examination prerequisites:** Active participation **Examination requirements:** Independent preparation and scientific publications and their presentation Time for preparation 4 weeks	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Ansgar Reiners
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: 18	

Additional notes and regulations: Einbringbar in den Wahlbereich nicht-physikalisch.

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0052: Logistic Management**	6 C 4 WLH
Learning outcome, core skills: The students • are able to define the term "logistics" and to differentiate the functions and subareas of logistics. • are able to classify the term "supply chain management" and derive the associated goals. • know the objectives and constraints of layout planning. • are able to classify transport and vehicle routing within the logistical context. • are able to use basic algorithms on simple problems of layout and transport planning as well as vehicle routing. • know the basic structures of queuing systems. • are able to use simple calculations for queuing systems. • are able to differentiate between the terms "storage requirement, functions, sorts and techniques". • are able to define the procedure of order-picking, know the different requirements and are able to define criteria for order-picking quality. • are able to use methods for a model-based decisions support in the field of operations research.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Logistikmanagement** (Lecture) *Contents*: In this lecture the fundamentals of logistics and logistics management are taught as an important part of corporate management. The focus is on the model-based decision-support in logistics. In particular, the areas of intra-company location planning, planning of transport and vehicle routing, queuing theory and storage techniques as well as the planning of the material flow are considered.	 2 WLH
2. Logistikmanagement (Exercise)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: In the module exam the students prove knowledge in following areas: • Fundamentals of logistics management • Intra-company location planning • Planning of transport and vehicle routing • Queuing theory • Storage and order-picking • Application of basic algorithms on problems of above topics	

Admission requirements:	**Recommended previous knowledge:**
none	Modul "Produktion und Logistik", Modul "Mathematik"

Language: English	**Person responsible for module:** Prof. Dr. Jutta Geldermann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0078: Global Virtual Project Management**	6 C 2 WLH
Learning outcome, core skills: Students will be able to understand the concepts of project planning and organization, conflict resolution and task management in a global virtual project environment. They will learn concepts related to organizational workflow including the staffing process, project planning elements and project communications. The course will also help students to improve their written and oral communication skills through formal writing assignments and group discussions.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Project work *Contents*: The aim of this course is to provide students with insight into global project management, managing cross-cultural teams, concepts of project planning as well as concepts related to organizational workflow. Special emphasis will be put on a so-called X-Culture project which provides students with an opportunity to experience global virtual project work with students across the globe. Working in cross-cultural teams for several weeks, students develop a business proposal. The task and the format of teamwork, as well as the collaboration tools used by the teams, are reminiscent of those used in the modern workplace, making the project a very realistic preview of work in corporate global virtual teams.	2 WLH
Examination: Presentation (approx. 20 minutes) with written report (max. 20 pages) **Examination requirements:** Experience of and ability to work on a global virtual project. Students need to give a presentation and submit a written report.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0081: Selected Issues in Corporate Governance**	6 C 3 WLH
Learning outcome, core skills: The students shall understand typical issues associated with Corporate Governance mechanisms. The goal is for students to take theoretical concepts as the basis for analyses of real life Corporate Governance problems. An in-depth understanding of the theory as well as their application in problem-solving is the aspired qualification.	**Workload:** Attendance time: 42 h Self-study time: 138 h
Course: Selected Issues in Corporate Governance *Contents*: The seminar addresses typical issues associated with Corporate Governance mechanisms and their respective interactions. Typical topics covered include incentive systems and compensation contracts of top management teams, the co-existence and cooperation of supervisory board and management in two-tier-systems or monitoring incentives and abilities of owners. These issues are analyzed in depth and their interdependencies as well as importance for the corporate world are discussed.	3 WLH
Examination: Presentation (approx. 30 min.) with written elaboration (max. 15 pages per person) in groups of 2-3	6 C
Examination requirements: Proof of knowledge of the theoretic basics in Corporate Governance as well as their application to problems observable in the real world and solving of these problems; critical discussion of the adequacy of the concepts in certain situations.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Jana Oehmichen
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0082: Seminar Corporate Valuation**	6 C 2 WLH

Learning outcome, core skills: In this course, students deal with basic theoretical and practical problems in corporate valuation based on capital market models. After an introduction into the topic, students work for themselves on theoretical or practical problems in the field of corporate valuation. They are expected to prove their knowledge by writing a thesis as well as presenting and critically discussing their results.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Seminar in Corporate Valuation (Seminar)	2 WLH

Examination: Presentation (approx. 50 minutes per group) with written elaboration (max. 12 pages) **Examination prerequisites:** regular participation	6 C

Examination requirements: Students are expected to prove their knowledge of scientific methods by writing a thesis as well as presenting their results in groups.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in Finance as well as Cost and Management Accounting and Financial Statements.
Language: English	**Person responsible for module:** Prof. Dr. Stefan Dierkes Dr. Ulrich Schäfer
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 5
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0084: Company Taxation in the European Union**	6 C 2 WLH

Learning outcome, core skills: Having attended this lecture the students • know the basic terms and concepts of domestic taxation in Germany and other EU member states, • know the basic terms and concepts of international taxation, especially the alternative forms of foreign business activity and methods to prevent double taxation, • know basics of European legal forms, • know significant ECJ decisions, • know possibilities for further tax harmonization in the European Union, • are able to identify main difficulties of group taxation in the European Union, • are able to sum up the main aspects of corporate taxation in different member states, • are able to differentiate the international taxation of different foreign business activities.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Company Taxation in the European Union (Lecture) *Contents*: The lecture gives an overview of the business tax systems in the EU member states and the basic structures of the relevant European law. It is the aim of this lecture that students understand these tax systems and learn about the impact of EU tax law on tax planning opportunities. Most notably students shall also focus on ways to harmonize company taxation in the European Union as well as on the European Commission's proposal of a common consolidated tax base.	2 WLH

Examination: Oral examination (approx. 30 minutes)	6 C

Examination requirements: Proof of ability about knowledge regarding company taxation in the EU member states and the basic structures of the relevant European law. Furthermore the proof of ability to understand the ways to harmonize company taxation in the European Union and on the European Commission's proposal of a common consolidated tax base.	

Admission requirements: none	**Recommended previous knowledge:** Unternehmenssteuern I (B.WIWI-BWL.0001)
Language: English	**Person responsible for module:** Prof. Dr. Andreas Oestreicher
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0087: International Marketing**	6 C 2 WLH
Learning outcome, core skills: After successful attendance the students should understand the foundations of international marketing as well as the diverse environments of global markets. Moreover, they should be able to assess global marketing opportunities and develop international marketing strategies.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: International Marketing (Lecture) *Contents*: • Introduction to international marketing • Social and cultural environments • Political, legal, and regulatory environments • Assessing global marketing opportunities • International marketing strategy (country selection, entry-modes, international marketing mix) • Branding across cultures The course conveys theoretical knowledge which is enriched by case studies.	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Foundations of international marketing, social, cultural, political and legal environments of global markets, assessing global marketing opportunities, developing international marketing strategies, branding across cultures	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Steffen Jahn
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module B.WIWI-BWL.0088: International Business	6 C 4 WLH
Learning outcome, core skills: Through learning about the opportunities and problems that are presented in a global business environment, students will be better able to understand the dynamics of global business. Key objectives include: Understanding the political, economic and cultural differences in international business; Recognizing issues, problems and procedures of international business operations in the global marketplace; Understanding how companies deal with these issues; and Applying international business concepts to real life examples (case studies).	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. International Business (Lecture)** *Contents*: This course is designed to provide a broad understanding of the scope and expansion of the business operations of multinational corporations (MNCs) in a rapidly changing global economy. Main topics include: The international business (IB) environment; Corporate policy and Strategy ; and Management of international operations.	 2 WLH
2. Case Study Discussion (Tutorial) *Contents*: The course will be based on case studies, readings, some presentations, and, above all, the debate and the exchange of ideas and experiences. Throughout the course, students will be encouraged to bring their insights and thoughts on the material assigned into class discussion.	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** The final exam is divided into two parts: multiple-choice (40%) and essay portion (60%). The multiple-choice questions will be based on the contents of the lectures and assigned reading materials. In the essay portion, there will be three questions from which you will choose two to answer. In the essays, you are expected to show that you have understood a certain IB concept and demonstrate how it can be applied to a real life example.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Jaime Bonache
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0089: Corporate Financial Management**	6 C 4 WLH

Learning outcome, core skills: After successful completion of the course students should be able to • understand and analyze different financial instruments (debt, equity, and hybrids) available to a corporation. • describe the debt characteristics and understand the global environment in which debt is issued.- critically assess different financing alternatives. • demonstrate a sound knowledge of different capital structure theories. • understand and critically assess the process of capital structure optimization. • understand the components of the cost of capital and why it might change over time. • critically apply the obtained knowledge to several realistic prob-lem sets. In the accompanying practice sessions students deepen and broaden their knowledge from lectures.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses: **1. Corporate Financial Management (Lecture)** *Contents*: 1. Introduction to corporate financial management 2. Equity financing: common stocks, IPOs, payout policies 3. Debt financing: corporate bonds, covenants, ABS 4. Capital structure & cost of capital 5. Hybrid financing: preferred stock, warrants & convertibles	2 WLH
2. Corporate Financial Management (Tutorial)	2 WLH

Examination: Written examination (90 minutes)	6 C

Examination requirements: • Demonstrate a profound knowledge of equity, debt and hybrid instruments available to corporations. • Document an understanding of how strategic financing deci-sions affect company value. • Demonstrate the ability to analyze and evaluate the effect of capital structure changes on the cost of capital and on compa-ny value. • Show a profound understanding of methods and techniques to manage a company's financing needs and tactical financing decisions.	

Admission requirements: none	**Recommended previous knowledge:** Modul "Einführung in die Finanzwirtschaft" Modul "Finanzmärkte und Bewertung"
Language: English	**Person responsible for module:** Dr. Alexander Merz
Course frequency:	**Duration:**

every second semester	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-BWL.0091: Asian Business and Economics**	6 C 2 WLH

Learning outcome, core skills:	**Workload:**
Due to the high growth rates in Asian countries and the intense economic ties between Europe and Asia, the topic of "Asian Business and Economics" becomes nowadays more and more important. The objective of this course is to impart theoretical and practical knowledge about the Asian continent from a business and economic perspective. The focus lies on the Asian region, on the success factors of Asian companies and on teaching intercultural skills that are needed to operate as foreign entrepreneurs or employees in Asia. Beside the acquisition of theoretical knowledge of the management of Asian companies, the students should be prepared for a future career in companies that have business relations with Asia.	Attendance time: 28 h Self-study time: 152 h

Course: Asian Business and Economics (Seminar)	2 WLH

Examination: Presentation (ca. 30 minutes) with written elaboration (max. 8.000 words)	6 C

Examination requirements:	
Proof of good skills about companies and their economic relations in Asia.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Yingying Zhang
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0041: Introduction to Development Economics**	6 C 4 WLH
Learning outcome, core skills: Students get an overview of topics in development economics: Theories, Models, Measurement, Policy relevance The idea is to introduce students to a relatively large number of interesting facts of development economics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Introduction to Development Economics (Lecture)** *Contents*: This undergraduate course, which will be taught in English, will deal with a wide range of issues relevant to less developed countries. In the beginning, the course gives an overview of the measurement and theories of development of countries. Then it turns to special topics in development economics as trade, population, agriculture, education and health. It concludes with the role of aid for development and the measurement of the impact of development aid.	 2 WLH
2. Introduction to Development Economics (Tutorial) *Contents*: The tutorial will focus on the analytical concepts discussed in the lecture, provide practical examples and show case studies.	2 WLH
Examination: Written examination (90 minutes)	
Examination requirements: In the exam students need to demonstrate a good understanding of key theories of development, empirical approaches to analyze economic development, and the role of education, health, population, and agriculture in the development process.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics I and II, Wachstum u. Entwicklung (previous or concurrent enrollment is recommended)
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module B.WIWI-VWL.0043: Political Economy	6 C 4 WLH
Learning outcome, core skills: This course discusses mainly about the determination of economic policies in a democracy, and focuses on modeling of policymaking in a representative democracy. Elements of a political system that will be analyzed include voters, political parties, interest groups and legislatures. Topics such as electoral competition, electoral accountability, lobbying, legislative bargaining and special-interest politics are intended to be studied. Students learn a methodology to analyze political economic issues in a democracy. They get familiar with the interaction between the elements of a political system, such as voters, political parties and interest groups.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Political Economy (Lecture)	2 WLH
2. Political Economy (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Good knowledge of the concepts developed in the module and of the mathematical tools used to analyze them	

Admission requirements: none	**Recommended previous knowledge:** Basic microeconomics, basic game theory
Language: English	**Person responsible for module:** Refik Emre Aytimur
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0058: Industrial Organization Theory**	6 C 4 WLH
Learning outcome, core skills: Students will learn to analyze the causes and consequences of firm behavior in different market structures. Students will also learn to evaluate the welfare consequences of different types of firm strategies and of market structures. Students will gain experience in analyzing economic issues in a formal and structured manner.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Industrial Organization Theory (Lecture)** *Contents*: This course includes mainly the analysis of firm behavior and market outcomes under different forms of imperfect competition. The course focuses also on welfare consequences. Special attention is given to the strategic aspects of firm behavior.	 2 WLH
2. Industrial Organization Theory (Tutorial)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Understanding of the main concepts and techniques developed in lectures and tutorial and ability to solve analytical exercises.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic microeconomics, basic game theory
Language: English	**Person responsible for module:** Refik Emre Aytimur
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: not limited	

Additional notes and regulations:
The courses "B.WIWI-VWL.0058: Industrial Organization Theoryare" and "B.WIWI-VWL.0038: Ausgewählte Fragestellungen der Volkswirtschaftslehre: Industrial Organization Theory" are equal. Students can conclude only one of these courses.

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0059: International Financial Markets**	6 C 2 WLH
Learning outcome, core skills: The course familiarizes students with the basic tools and concepts of international finance, including the balance of payment, exchange rates and trade. It focuses on understanding the international financial system. Further, aspects of financial globalization and multilateral institutions will also be discussed. The course enables students to follow to debate about the pros and cons of international financial markets with a deeper and wider theory based background.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: International Financial Markets (Lecture) *Contents*: • Basic concepts • Determining the exchange rate • Short term risks and long-term concepts • Exchange rate systems • Financial Globalization	2 WLH
Examination: Written examination (90 minutes)	
Examination requirements: Students demonstrate a good understanding of the basic tools and concepts of international finance.	

Admission requirements: none	**Recommended previous knowledge:** Econometrics I
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0060: Intertemporal Choice and Saving**	6 C 2 WLH
Learning outcome, core skills: Students acquire knowledge of the most relevant determinants of economic agents' consumption and saving decisions, which is crucial to understanding several topics involved in modern economic and political debates, like the relationship between capital accumulation and economic growth. Further, students are expected to learn how to apply their statistical knowledge to relevant economic questions.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Intertemporal Choice and Saving (Lecture) *Contents*: This course aims at analyzing recent theoretical contributions on the economics of intertemporal choice and saving, and their empirical counterparts. The main focus will be on studying models of intertemporal and allocative choices of rational agents with a set of preferences (defined over consumption and assets) and endowments. The statistical and economic significance of the models' predictions is also highlighted. Starting from the well-known life-cycle and permanent income hypotheses, we will introduce and investigate topics like credit market imperfections (e.g. rationing), income uncertainty and its effects on optimal saving, the interplay of investment and consumption decisions, fiscal incentives and social security.	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Good understanding of the techniques, methodologies and frameworks developed in the module, and ability to apply them to analyze economic questions related to the intertemporal allocation of consumption and saving in world of uncertainty and credit market imperfections.	

Admission requirements: none	**Recommended previous knowledge:** Microeconomic theory, Basic Mathematics and Statistics
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marco Maria Sorge
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 5 - 6

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0061: Dynamic Macroeconomics**	6 C 2 WLH
Learning outcome, core skills: Students are expected to become familiar with highly sophisticated methodologies/frameworks through the lens of which scholars and policy institutions look at aggregate macroeconomic phenomena, such as business cycle fluctuations and the welfare effects of (monetary and/or fiscal) policy changes.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Dynamic Macroeconomics (Lecture) *Contents*: This course's aim is to introduce students to the recent literature on business cycle theory and econometrics. The course focuses on basic techniques for constructing, solving and estimating (linearized) Dynamic Stochastic General Equilibrium (DSGE) models, like e.g. the Kalman filter and Bayesian estimation. Topics include, but are not limited to, the following: i) Solving Rational Expectations (RE) models (e.g. Perturbation methods); ii) Identification of linearized DSGE models; v) Kalman filtering theory and ML estimation of linearized DSGE models.	2 WLH
Examination: Written Examination (90 minutes)	6 C
Examination requirements: Good understanding of the techniques, methodologies and frameworks developed in the module.	

Admission requirements: none	**Recommended previous knowledge:** Mathematics and Statistics, Basic Macroeconomics
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marco Maria Sorge
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 5 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0068: Aspects of European Integration**	6 C 3 WLH

Learning outcome, core skills:	**Workload:**
The students: • Know the rationale for the EU Single Market programme. • Know basic methods and issues in assessing the impact on economic outcomes of structural reform in labour and product markets. • Understand the concepts of potential output and employment. • Know the key features of the "European Semester". • Know the ECB's main monetary policy instruments, policies and transmission channels before, during and after the financial crisis. • Understand the rationale for macro-prudential policies, supervision and resolution of banks and financial institutions and know the main actors and instruments. • Can discuss the main issues in establishing a "banking union" and a "capital markets union". • Know the key features of the EU fiscal governance system, its strengths and weaknesses and options for reform. • Can discuss the main economic forces behind the recent economic crisis and main related issues in financial, fiscal and macro policies.	Attendance time: 42 h Self-study time: 138 h

Courses:	
1. Aspects of European Integration (Lecture) *Contents*: The first part of the course deals with main institutions, provisions and concepts underpinning the EU single market. It reviews potential static and dynamic gains of product and factor market integration, and considers stylised facts about EU trade integration and migration. It introduces EU competition and state aid policies. It explains the concepts of potential output and output gaps, and their link to macroeconomic and structural policy analysis and EU economic governance. The second part deals with key institutional and policy issues of monetary union and financial markets. It discusses the pros and cons of a single currency and considers the operation of the System of European Central Banks and main characteristics of monetary policy in the euro area. Selective policy issues in financial market integration are addressed, including essential reform measures taken in response to the financial crisis. Attention is paid to the main drivers of the financial crisis. The third part is devoted to fiscal policy and governance. It introduces main concepts for fiscal policy assessment, such as structural government balances and the sustainability of government finances, and discusses fiscal policy channels, potential externalities, EU fiscal surveillance and approaches to secure sustainable government finances.	2 WLH

The last part considers EU economic performance targets and looks on key features of EU economic surveillance and policy coordination.	
2. Aspects of European Integration (Exercise)	1 WLH

Examination: Written examination (90 minutes) **Examination prerequisites:** Two term paper (max. 3 pages per term paper)	6 C

Examination requirements: Students need to demonstrate a good understanding of the role of key regulatory and macroeconomic polices and institutions for economic development of the European Union and the euro area.	

Admission requirements: none	**Recommended previous knowledge:** Mikroökonomie I, Makroökonomie I
Language: English	**Person responsible for module:** Dr. Eckhard Wurzel
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0069: Topics in Urban Economics**	6 C 4 WLH
Learning outcome, core skills: The students learn about core economic concepts of urban economics and familiarize themselves with data sources that can be used to measure and investigate various dimensions of urban and regional development. Students learn to visualize and analyze urban and regional data and perform and document an own statistical analysis on a selected topic.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Topics in Urban Economics** (Lecture) *Contents*: The lecture discusses issues of agglomeration and the development of cities, land-use patterns, and a number of selected further issues related to urban transportation, education, crime, environment, housing and local government. It introduces basic concepts of urban economics and examines related global evidence.	 2 WLH
2. Topics in Urban Economics (Exercise) *Contents*: The exercise introduces the statistical analysis of urban and regional data with the help of the freely available statistical software R. The students learn about a number of sources for urban (and other spatially explicit) data as well as basic data management and mapping techniques in R, which prepare them for conducting a descriptive data analysis on their own.	2 WLH
Examination: Practical examination with written elaboration (max. 15 pages)	6 C
Examination requirements: Each student chooses one topic related to the lecture, identifies relevant data sources, compiles the data using the statistical software R and performs a descriptive analysis of the data using the same statistical program. The exam consists of a documentation of the analysis: students have to explain the problem they investigate and provide a descriptive analysis including maps, graphs and tables.	

Admission requirements: none	**Recommended previous knowledge:** BA courses in Econometrics and Statistics BA courses in Microeconomics
Language: English	**Person responsible for module:** Prof. Dr. Krisztina Kis-Katos
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.WIWI-VWL.0070: International economic policy**	6 C 3 WLH
Learning outcome, core skills: The course introduces core areas of international economic policy. The students should become familiar with the economic drivers of international cooperation (or the absence of it) in various areas and should be able to discuss and evaluate economic arguments with respect to current issues of international economic policy.	**Workload:** Attendance time: 42 h Self-study time: 138 h
Courses: **1. International economic policy** (Lecture) *Contents*: The lecture covers a range of issues related to international cooperation: among others, international trade agreements, international environmental agreements, and the role of supra-national institutions (focusing among others on the institutions of the European Union).	 2 WLH
2. International economic policy (Exercise) *Contents*: The exercise sessions discuss issues related to the course material (in form of problem solving and discussing descriptive evidence and current issues) and contain a block session with a simulated policy debate.	2 WLH
Examination: Written examination (90 minutes)	
Examination requirements: The exam tests the understanding of economic arguments addressing the drivers of international cooperation as well as the arising problems.	

Admission requirements: none	**Recommended previous knowledge:** Courses on Microeconomics and Macroeconomics, International Economics
Language: English	**Person responsible for module:** Prof. Dr. Krisztina Kis-Katos
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module B.WIWI-WB.0003: Introduction to Stata	3 C 2 WLH
Learning outcome, core skills: Students will obtain the necessary skills to conduct their own empirical analysis with the statistical software package Stata.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Computer lab sessions *Contents*: The course covers the main functionalities of Stata: basic syntax, trouble-shooting, loading and examining data, workflow considerations, combining datasets, regressions, and graphs. Depending on time availability, students may also be introduced to somewhat more advanced topics (e.g. the basics of Stata programming).	2 WLH
Examination: Practical examination **Examination requirements:** Students are required to complete an empirical project and submit the code and thus show that they are able to conduct basic empirical analysis based with the software.	3 C

Admission requirements: none	**Recommended previous knowledge:** Introductory Econometrics/Statistics
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: 20	

Additional notes and regulations:
The course is suitable for advanced BA, who have no or at most limited knowledge of STATA. However, it is strongly recommended that students have acquired a solid knowledge of main ideas in statistics and econometrics.

Georg-August-Universität Göttingen **Module M.AS.01: Advanced Cultural and Media Studies**	9 C 4 WLH

Learning outcome, core skills: Students • acquire profound knowledge in North American media and cultural studies • are able to approach a text analytically and practically with the systematical-theoretical parameters of the discipline • use diachronic and synchronic approaches to “Advanced American Cultural Studies” and are thus enabled to describe, analyze and assess cultural problems • analyze and interpret non-literary media in North American cultural history from the perspective of cultural and media studies	**Workload:** Attendance time: 56 h Self-study time: 214 h

Course: Cultural studies seminar "Advanced American Cultural History and Rhetoric" or an equivalent course in another subject (Seminar)	2 WLH
Examination: 2 take home exams (max. 2000 words each) (max. 4000 words) (max. 4000 words)	5 C

Course: Introductory seminar in culture theory or media studies (Seminar)	2 WLH
Examination: Oral Presentation (approx. 30 minutes)	4 C

Examination requirements: Students must be able to analyze and interpret both literary and non-literary texts in an academically complex and elaborate manner; students must be able to develop and present their own ideas for research	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.AS.02: American Literature**	11 C 4 WLH
Learning outcome, core skills: Students • acquire advanced knowledge in North American literary and cultural theory and history • are able to approach a text analytically and critically with the systematical-theoretical parameters of the discipline in order to analyze complex research problems on an advanced theoretical level • develop, expand and validate their own research theses and assumptions based on literary and cultural theory as well as literature and cultural history pertaining to North American Studies • present and discuss their research results on an advanced academic level, both in oral and in written form	**Workload:** Attendance time: 56 h Self-study time: 274 h
Course: Advanced Literature and Cultural Theory Analysis (Seminar)	2 WLH
Examination: Term Paper (max. 7500 words)	6 C
Course: Advanced Literature and Cultural Theory Analysis (Seminar)	2 WLH
Examination: 2 essays (max. 2000 words each) (max. 4000 words) (max. 4000 words)	5 C
Examination requirements: Students are familiar with topic-related literary and cultural theory; they are capable of analyzing and interpreting texts in a context- and theory-based manner and of transferring knowledge; they are able to approach and analyze secondary literature independently and critically; they are capable of phrasing complex research theses as well as discussing them critically	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.AS.03a: Cultural History of American Literature I	12 C 4 WLH

Learning outcome, core skills: Students • acquire comprehensive knowledge in literary and cultural history by studying the major works of seminal periods in North American literary history • critically describe and compare texts, key concepts and theories of epochs • apply advanced methods of text analysis and interpretation	**Workload:** Attendance time: 56 h Self-study time: 304 h

Course: 1st lecture on the cultural history of American literature and, addressing one of four epochs (Lecture)	2 WLH
Examination: Written examination (120 minutes)	6 C

Course: 2nd lecture on the cultural history of American literature, addressing one of four epochs (Lecture) If a student registers for module M.AS.03b, it is mandatory that the epochs in module M.AS.03a and module M.AS.03b are not the same.	2 WLH
Examination: Written examination (120 minutes)	6 C

Examination requirements: Comprehensive knowledge about one epoch in North American cultural history of literature; critical reflection of the aesthetic developments, the major works, and the cultural contexts of the epoch in question	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester; jedes Semester (4-semestriger Zyklus: jedes Semester wird eine von vier Epochen angeboten)	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 10	

Georg-August-Universität Göttingen Module M.AS.03b: Cultural History of American Literature II	6 C 2 WLH
Learning outcome, core skills: Students • acquire comprehensive knowledge in literary and cultural history by studying the major works of seminal periods in North American literary history • critically describe and compare texts, key concepts and theories of epochs • apply advanced methods of text analysis and interpretation	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: lecture on the cultural history of American literature (Lecture) If a student has already completed module M.AS.03a, it is mandatory that the epochs in module M.AS.03a and module M.AS.03b are not the same.	2 WLH
Examination: Written examination (120 minutes)	6 C
Examination requirements: Students must be able to critically engage with texts and key concepts of the epoch in question; comprehensive knowledge about on epoch in North American cultural history of literature; critical reflection of the aesthetical developments, the major works, and the cultural contexts of the epoch in question.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: jedes Semester (4-semestriger Zyklus: jedes Semester wird eine von vier Epochen angeboten)	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.AS.04: North American Studies (Degree Course)**	6 C 4 WLH

Learning outcome, core skills: Students • acquire comprehensive and profound detailed literary and cultural knowledge in the field of North American Studies • can critically engage with diachronic and synchronic parameters of the discipline; students can employ and assess the tools, discourses, and parameters of North American literary and cultural studies; the can critically reflect on research problems • independently engage with, reflect on as well as apply interdisciplinary methods and questions of research	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Advanced seminar in North American Studies (Seminar)	2 WLH
2. Colloquium in North American Studies	2 WLH

Examination: Oral examination (approx. 25 minutes)	6 C

Examination requirements: Subject-specific and advanced knowledge of theories, methods and the literary and cultural history of North American Studies; the ability to present research concepts concerning individual authors, texts and key concepts and projects, critically approach and assess authors, texts, and key concepts of an epoch or a field in media/cultural theory.	

Admission requirements: M.AS.01, M.AS.02	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 10	

Georg-August-Universität Göttingen Module M.Bio.141: General and applied microbiology	3 C 3 WLH
Learning outcome, core skills: **Learning outcome:** Evolution and phylogenetic system; morphology and cell biology; communities and biocoenosis of bacteria and archaea; gene expression and molecular control (transcription, translation); posttranslational control, protein stability and proteomics; genetic networks; molecular switches and signal transduction; microbial developmental biology; mechanisms of pathogenicity of important pathogens; development of new antimicrobial agents; diversity of the metabolism in bacteria and archaea as basis for biotechnological applications; industrial microbiology. **Core skills:** Knowledge of microorganisms relevant for biotechnology and medicine, ability to identify these organisms and to analyse them with molecular methods.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: lecture: General and applied microbiology (Lecture)	3 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: detailed knowledge in cell biology, biochemistry and genetics of procaryotic microorgansims	

Admission requirements: can't be combined with core module M.Bio.101	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Jörg Stülke
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.142: Molecular genetics and microbial cell biology**	3 C 3 WLH

Learning outcome, core skills: Advanced knowledge of Molecular Genetics and microbial cell biology through case studies of model systems of molecular mycology (yeasts and filamentous fungi). Acquisation of knowledge up to the "Review" level in one topic.	**Workload:** Attendance time: 42 h Self-study time: 48 h

Course: Molecular genetics and microbial cell biology (Lecture)	3 WLH

Examination: Written examination (120 minutes)	3 C

Examination requirements: detailed knowledge in cell biology, biochemistry and genetics of eucaryotic microorgansims	

Admission requirements: Can´t be combined with Core Module M.Bio.102	**Recommended previous knowledge:** • Watson, Molecular Biology of the Gene, Pearson, 6th Edition • Alberts, Molecular Biology of the Cell, Garland, 5th Edition
Language: English	**Person responsible for module:** Prof. Dr. Gerhard Braus
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.144: Cellular and molecular biology of plant-microbe interactions**	3 C 3 WLH

Learning outcome, core skills: Introduction into theory and methods for the analysis of plant-microbe interactions on the cell biological and molecular level.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: lecture: Plant-microbe-interactions (Lecture)	3 WLH
Examination: Written examination (54 minutes)	
Examination requirements: knowledge of basic concepts in plant-microbe-interactions	

Admission requirements: Can´t be combined with core module M.Bio.104	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christiane Gatz Prof. Dr. Volker Lipka
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.156: Structural biochemistry**	3 C 3 WLH
Learning outcome, core skills: Methods in Structural Biology,structure and function of biological macromolecules. Structure and folding of proteins, structure-function relationships, protein-protein and protein-nucleic acid complexes. Structure-based drug-design	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: lecture: Structural Biology (Lecture)	3 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: The students show that they know the basics of structural biology. They are familiar with biochemical and analytical methods in protein and macromolecular complex- analysis. They have deepened knowledge about selected proteins and protein complexes. The students know the basics in structural resolution and structural characteristics of proteins.	

Admission requirements: can't be combined with M.Bio.105	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ralf Ficner
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.157: Biochemistry and biophysics**	3 C 3 WLH

Learning outcome, core skills: Molecular biochemistry and biophysics of different classes of biomolecules, plant primary and secondary metabolism, lipid metabolism, lipids as signal molecules and secondary metabolites, biotechnological utilization and modification of storage substances, enzymes of lipid metabolism, modern biophysical methods for analysis of biomolecules Handling of state of the art equipment, critical dealing with current biochemical topics, detailed analysis of experiments and their presentation. Independent acquisition of professional knowledge from publications by active participation in the seminar.	**Workload:** Attendance time: 42 h Self-study time: 48 h

Course: lecture: Biochemistry and Biophysics (Lecture)	3 WLH

Examination: Written examination (90 minutes)	3 C

Examination requirements: • basic knowledge of different classes of biomolecules and their metabolism • knowledge about spectroscopy of molecules • biotechnologic techniques using plants	

Admission requirements: can't be combined with M.Bio.106	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ivo Feußner
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.158: Enzyme catalysis and biological chemistry**	3 C 3 WLH
Learning outcome, core skills: Catalytic mechanisms of enzymes, mechanisms of macromolecular complexes, biocatalysis, kinetics und thermodynamics of biochemical reactions, chemical model systems of enzymes, synthesis of biooligomers, synthesis of ligands, ligation techniques, array technologies	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: lecture: Enzyme Catalysis and Chemical Biology (Lecture)	3 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: • knowledge about kinetics and thermodynamics of biochemical reactions • knowledge about different organic synthesis mechanisms • knowledge about catalytic mechanisms of enzyme	

Admission requirements: can't be combined with M.Bio.107	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Kai Tittmann
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.341: Developmental biology of invertebrates (key competence module)**	6 C 4 WLH

Learning outcome, core skills: Profound insights into principles of developmental biology and developmental genetics in selected invertebrates. Understanding of methods to idenitify, analyse and manipulate gene function. Knowledge of important data bases for in silicio sequence analysis and model system specific data bases. Basic insights into the evolution of developmental processes. Critical analysis of results, scientific presentation and discussion of data.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Development and evolution of invertebrates (Lecture)	2 WLH
2. Development and evolution of invertebrates (Seminar)	1 WLH
3. tutorial: Exercises to the lecture "Development and evolution of invertebrates"	1 WLH

Examination: Written examination (90 minutes) **Examination prerequisites:** oral presentation (~ 20 min)	6 C

Examination requirements: Profound knowledge of principles in developmental biology and developmental genetics in invertebrates based on the contents of the lecture and the additional teaching material provided by the lecturer. Comprehension of methods used to identify, analyze and manipulate gene functions as well as the analysis of developmental processes. Knowledge of different model systems with their respective pros and cons. Ability to transfer this knowledge to new scientific problems (i.e. suggestions of useful experiments and discussion of possible results).	

Admission requirements: can't be combined with M.Bio.301 or M.Bio.361	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Gregor Bucher Prof. Dr. Ernst Wimmer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 5	

Georg-August-Universität Göttingen **Module M.Bio.344: Neurobiology 1 (key competence module)**	3 C 2 WLH
Learning outcome, core skills: Profound knowledge of essential techniques in molecular, cellular and systemic neuroscience and their application.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: From gene to behavior (Lecture)	2 WLH
Examination: Written examination (120 minutes)	3 C
Examination requirements: Theoretical knowledge of the basic methods in neuroscience based on the contents of the lecture.	

Admission requirements: can't be combined with module M.Bio.304	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Martin Göpfert
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 27	

Georg-August-Universität Göttingen **Module M.Bio.345: Neurobiology 2 (key competence module)**	3 C 2 WLH
Learning outcome, core skills: Profound knowledge of current concepts in neuroscience	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Current questions and concepts in neurosciences (Lecture)	2 WLH
Examination: Written examination (120 minutes)	3 C
Examination requirements: Profound knowledge in a range of current concepts in neuroscience including detailed knowledge of specific classical and novel topics.	

Admission requirements: can't be combined with core module M.Bio.305	**Recommended previous knowledge:** M.Bio.304
Language: English	**Person responsible for module:** Prof. Dr. Andre Fiala
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 27	

Georg-August-Universität Göttingen **Module M.Bio.347: Behavioral biology (key competence module)**	6 C 4 WLH
Learning outcome, core skills: Profound knowledge of the priciples of the evolutionary approach in behavioral analyses. Students are able to present and discuss scientific issues in oral and written form. They know how to plan and realize simple projects and experiments from the field of behavioral biology.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Behavioral biology** (Lecture) **2. Behavioral biology** (Seminar)	 3 WLH 1 WLH
Examination: Term Paper (max. 10 pages) **Examination prerequisites:** oral presentation (~ 15 min)	6 C
Examination requirements: Profound knowledge of determinants and mechanisms of behaviour. Ability to use important methods of behavioral biology.	

Admission requirements: M.Bio.306 or M.Bio.346: Introduction to Behavioral Biology can't be combined with core module M.Bio.307 or key competence module M.Bio.367	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Claudia Fichtel
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Bio.348: Human genetics (key competence module)**	6 C 4 WLH

Learning outcome, core skills: Profound knowledge of specific human genetic aspects and principles of research in human genetics. Understanding of the methods for identification, analysis and manipulation of genes and gene functions. Basic insights into the structure and function of the human genome. Critical analysis of results from scientific publications. Scientific presentation and discussion of data.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Human genetics II (Lecture)	2 WLH
2. Tumor genetics; Reproduction genetics; Stem cells (Seminar) participation in two of the offered seminar series	2 WLH

Examination: written examination (60 min) and oral presentation (ca. 45 min)	6 C

Examination requirements: Profound knowledge of specific aspects and the basic principles in human genetic research. Analysis and presentation of scientific data.	

Admission requirements: can't be combined with core module M.Bio.309 or key competence module M.Bio.369	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. rer. nat. Anja Uhmann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Bio.359: Development and plasticity of the nervous system (lecture)**	3 C 2 WLH

Learning outcome, core skills: The basics of the development and plasticity of the vertebrate nervous system are presented. Special emphasis is on the 3 following subjects: i) early development of the nervous system (induction and pattern formation, formation and survival of nerve cells, development of specific axonal projections, synaptogenesis), ii) developmental plasticity (experience- and activity-dependent development of the brain, critical periods) and iii) adult plasticity and regeneration (learning-induced plasticity, cellular mechanisms of plastic changes, neurogenesis, therapies after brain lesions). Deepened knowledge, up-to-date research results and understanding of scientific approaches in the field of the development and plasticity of the nervous system.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: lecture: Development and plasticity of the nervous system (Lecture)	2 WLH
Examination: Oral examination (approx. 15 minutes)	3 C
Examination requirements: Profound knowledge of recent reserach and understanding of scientific methods in the field of development and plasticity of the nervous system.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Siegrid Löwel
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 35	

Georg-August-Universität Göttingen **Module M.Bio.360: Development and plasticity of the nervous system (seminar)**	3 C 2 WLH

Learning outcome, core skills: The students learn to present up-to-date publications on the development and plasticity of the nervous system and to discuss the results critically in a seminar report. Deepened knowledge, up-to-date research results and understanding of scientific approaches in the field of the development and plasticity of the nervous system. Critical discussion of up-to-date literature, scientific debate, sharpening of critical thought, promotion of multidisciplinarity. Training in presentation techniques and scientific writing.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: seminar: Development and plasticity of the nervous system (Seminar)	2 WLH

Examination: oral presentation (~ 20 min) and essay (~ 8 pages)	3 C

Examination requirements: Profound knowledge of recent research and scientific methods in the field of development and plasticity of the nervous system.	

Admission requirements: attendance of M.Bio.359	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Siegrid Löwel
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Bio.361: Developmental biology of invertebrates (key competence module)**	3 C 2 WLH
Learning outcome, core skills: Profound insights into principles of developmental biology and developmental genetics in selected invertebrates. Basic insights into the evolution of developmental processes.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Development and evolution of invertebrates (Lecture)	2 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: Profound knowledge of principles in developmental biology and developmental genetics in invertebrates based on the contents of the lecture and the additional teaching material provided by the lecturer. Comprehension of methods used to identify, analyze and manipulate gene functions as well as the analysis of developmental processes. Knowledge of different model systems with their respective pros and cons. Ability to transfer this knowledge to new scientific problems (i.e. suggestions of useful experiments and discussion of possible results).	

Admission requirements: can't be combined with M.Bio.301 odeer M.Bio.341	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Gregor Bucher Prof. Dr. Ernst Wimmer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Bio.366: Introduction to behavioral biology (key competence module)**	3 C 3 WLH
Learning outcome, core skills: Profound knowledge of basic concepts in behavioral biology with special emphasis on behavioral ecology, sociobiology and cognition. Special consideration of the quantitative aspect of behavioral research. Students are able to present and discuss scientific issues in written form.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Introduction to behavioral biology (Lecture)	2 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: Profound knowledge of basic concepts and the quantitative aspect of behavioral research	

Admission requirements: can't be combined with core module M.Bio.306 or key competence module M.Bio.346	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Cornelia Kraus
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 4	

Georg-August-Universität Göttingen **Module M.Bio.367: Behavioral biology (key competence module)**	3 C 3 WLH
Learning outcome, core skills: Profound knowledge of the principles of the evolutionary approach in behavioral analyses. Students are able to present and discuss scientific issues in written form.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Course: Behavioral biology (Lecture)	3 WLH
Examination: Term Paper (max. 10 pages)	3 C
Examination requirements: Profound knowledge of determinants and mechanisms of behaviour. Ability to use important methods of behavioral biology.	

Admission requirements: core module M.Bio.306: Introduction to behavioral biology, can't be combined with core module M.Bio.307 or key competence module M.Bio.347	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Claudia Fichtel
Course frequency: each summer semester	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 8	

Georg-August-Universität Göttingen **Module M.Bio.369: Human genetics (key competence module)**	3 C 2 WLH
Learning outcome, core skills: Profound knowledge of specific human genetic aspects and principles of research in human genetics. Understanding of the methods to identify, analyze and manipulate genes and their function. Basic insights into the structure and function of the human genome.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Human genetics II (Lecture)	2 WLH
Examination: Written examination (60 minutes)	3 C
Examination requirements: Profound knowledge of specific aspects and the basic principles in human genetic research.	

Admission requirements: can't be combined with core module M.Bio.309 or key competence module M.Bio.348	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. rer. nat. Anja Uhmann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Biodiv.402: Plant ecology and ecosystems research**	6 C 4 WLH
Learning outcome, core skills: The students • acquire an overview of the most important habitats all over the world and their respective vegetation and ecology • acquire a global overview of the anthropogenous causes of ecosystem burdens • acquire profound knowledge of the habitats of exemplarily selected climate zones and their ecology • know basic correlations between climate, soil and vegetation on different continents • acquire profound knowledge on how the global change of land use and the global warming influence vegetation and ecosystem processes • are able to analyze topics of ecosystematic and global aspects of plant ecology independently and prepare a presentation of their findings	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. M.Biodiv.402.1: Vegetation & ecology of the world** (Lecture) or **2. M.Biodiv.402.2: Global materials cycles** (Lecture) or **3. M.Biodiv.402.8: Ecosystems research, carbon balance & global warming** (Lecture)	2 WLH
4. M.Biodiv.402.4: Current topics in plant ecology and nature conservation (Seminar) or **5. M.Biodiv.402.6: Aut- and synecology of plants: the tropics** (Seminar) or **6. M.Biodiv.402.11: Vegetation and ecology of Eurasian and North American steppes** (Seminar)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Oral presentation (max. 25 minutes) **Examination requirements:** Knowledge of ecosystematic and global aspects of plant ecology and possible impacts of the climate change on terrestrial ecosystems. Knowledge of the change in land use and its impacts on the structure of species in the different vegetation areas of the earth.	6 C

Admission requirements: none	**Recommended previous knowledge:** none

Language: English, German	**Person responsible for module:** Prof. Dr. Christoph Leuschner
Course frequency: once a year; jedes WiSe: 402.1; 402.2; 402.4; 402.6; 402.8; jedes SoSe: 402.11	**Duration:** 1 - 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.Biodiv.403: Vegetation ecology and vegetation history	6 C 4 WLH
Learning outcome, core skills: The students acquire knowledge and a profound understanding of temporal and spatial vegetation patterns; one focus lies on biomes, climate zones and other large-scale vegetation areas, another focus lies on biological and geobotanical principles and basics on different scale levels and in different natural environments. Perception and knowledge in basic and applied fields of advanced vegetation ecology, vegetation history, sociology and chorology of plants, conception and reception of scientific papers; presentation skills.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. M.Biodiv.402.1 Vegetation and ecology of the world** (Lecture) or	
2. M.Biodiv.403.1 General and plant sociological vegetation ecology (Lecture) or **3. M.Biodiv.403.2 General vegetation history of the world** (Lecture)	2 WLH
4. M.Biodiv.403.3 Applied vegetation ecology in the Mediterranean area (Seminar) or **5. M.Biodiv.403.4 Modern issues of vegetation science in agricultural landscapes** (Seminar) or **6. M.Biodiv.402.11 Vegetation and ecology of Eurasian and North American steppes** (Seminar)	2 WLH
Examination: Oral presentation (ca. 30 minutes) **Examination requirements:** Knowledge of temporal and spatial vegetation patterns with focus on biomes, climate zones and other large-scale vegetation areas.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Erwin Bergmeier Prof. Dr. Hermann Behling
Course frequency: jedes WiSe: 402.1; 403.1; 403.3; jedes SoSe: 402.11; 403.2	**Duration:** 1 - 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 16	

Georg-August-Universität Göttingen Module M.Biodiv.404: Animal ecology	6 C 4 WLH
Learning outcome, core skills: The lecture presents principles and theories of ecology and introduces current topics of ecological research. Topics include population ecology, interactions in animal communities, food webs, biodiversity and ecological theories. The seminar covers current topics of ecological and evolutionary research. In the seminar the students acquire advanced knowledge of methods and strategies to analyze ecological communities. Knowledge of ecological theories and modelling. Principles of animal populations and food webs. Experimental and statistical methods for the analysis of animal communities. Knowledge of current topics of animal ecological and evolutionary biology research.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Animal ecology (Lecture)	2 WLH
2. Topics of animal ecology and evolution (Seminar)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Oral presentation (ca. 20 minutes) **Examination requirements:** Knowledge of ecological principles and theories, population models. Functional responses, analysis and modelling of biotic interactions and food webs. Biodiversity and ecosystem functioning.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Stefan Scheu
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Biodiv.408: Primate ecology**	6 C 8 WLH
Learning outcome, core skills: Learning outcome: Get to know ecological principles and methods with non-human primates as model organisms. Core skills: Design and realization of ecological studies; critical inspection and evaluation of relevant literature; competent handling of damageable equipment (telemetry).	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses: **1. Primate ecology** (Lecture) **2. Primate ecology** (Exercise)	 2 WLH 6 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Ecological knowledge, especially concerning primates and their interactions with the environment; knowledge of ecological studies on primates; scientific presentation of results.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Eckhard W. Heymann
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Module M.Biodiv.412: Nature conservation biology	6 C 4 WLH
Learning outcome, core skills: The module imparts the basic knowledge necessary to complete the advanced modules in Nature Conservation. Detailed knowledge is provided on the development of Conservation Biology as a scientific field (M.Biodiv.412-2), on current questions in Nature Conservation (M.Biodiv.412-1, 412-3) and on Conservation Politics (M.Forst.1212.2, M.Forst.1512). Professional skills at the interface between conservation research, the development of conservation strategies and their realization under socio-political conditions. Knowledge of political decision-making under scientific and economical operation guidelines.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. One lecture from the following options:** • M.Biodiv.412-1 International nature conservation *or* • M.Biodiv.412-2 The song of the Dodo - Origins of conservation biology *or* • M.Forst.1212.2 Analysis of policy for nature conservation	 2 WLH
2. One seminar from the following options: • M.Biodiv.412-3 Botanical nature conservation and environmental protection *or* • M.Forst.1512 Global environmental and forest policy	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Oral presentation (max. 30 minutes) **Examination requirements:** Knowledge from the scientific fields which form the basis of Conservation Biology, its history, Conservation Politics on a national and international scale and the political dimensions of Nature Conservation.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** PD Dr. rer. nat. Matthias Waltert
Course frequency: each winter semester; 412-3 jedes SoSe	**Duration:** 1 - 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Biodiv.415: Evolution: Evolutionary biology**	6 C 4 WLH
Learning outcome, core skills: The lecture "Evolutionary Biology" introduces the basics of the different elements of the theory of evolution, the mechanisms of evolution as well as the methods of evolutionary biology. The lecture is given by docents from the departments participating in the module "Evolutionary Biology". Therefore the lecture also provides insight into the working areas and research interests of the individual departments. The lecture "Phylogenetic Systematics" introduces the basics of the theory and methods of cladistics beginning with a historical insight into the biological classification approaches prior to Hennig. To this, adequate case examples are presented and contradictory hypotheses on the phylogeny of individual taxa are discussed. The lecture "Phylogeography" considers the relation between biogeography, population biology and ecology and the phylogeny of primates. Biogeographical aspects (adaptive radiations, isolations etc.) as codeterminants for the origin of species are highlighted. Acquisition of an overview of the mechanisms underlying the evolution of organisms and of the current state of knowledge of the origin of the biological diversity on earth.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. M.Biodiv.415.1: Evolutionary biology (Lecture)	2 WLH
You have to attend the lecture M.Biodiv.415.1 and one lecture of the following two:	
2. M.Biodiv.415.2: Phylogenetic systematics (Lecture)	2 WLH
3. M.Biodiv.415.3: Phylogeography (Lecture)	
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of the theory of evolution, the principles and mechanisms of evolution as well as of the methods of botanical and zoological evolutionary biological research.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basics in phylogenetic systematics are expected.
Language: German	**Person responsible for module:** Prof. Dr. Thomas Friedl
Course frequency: jedes WiSe: 415.1; 415.2 jedes SoSe: 415.3	**Duration:** 1 oder 2
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Biodiv.418: Pro- and eucaryotic algae: Evolution and systematics**	6 C 4 WLH

Learning outcome, core skills: Knowledge of the diversity of eukaryotic algae and cyanobacteria. Knowledge of current concepts of the evolution of eukaryotes and the diversity and origin of plastids; overview of possible applications of this knowledge in biotechnology and ecology. Core skills: • Understanding to classify the characteristics of cyanobacteria and photoautotrophic eukaryotes in an evolutionary context; • understanding of current developments in the economic use of cyanobacteria and eukaryotic algae; • overview of modern methods of analysis in biodiversity research such as DNA barcodes and reconstructions of phylogeny.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. M.Biodiv.418.1: Phylogeny and systematics of plants and algae: biology und phylogeny of algae	2 WLH
2. M.Biodiv.418.2: Plant Systematics: Phycology (Seminar)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Oral presentation (ca. 20 minutes)	6 C

Examination requirements: Knowledge of the biodiversity of eukaryotic algae and cyanobacteria; current concepts of the evolution of eukaryotes and the origin of plastids; knowledge of applications of pro- and eukaryotic algae in biotechnology.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Thomas Friedl
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Biodiv.419: Pro- and eucaryotic algae: Algae and lichens**	6 C 7 WLH
Learning outcome, core skills: The students have deepened knowledge of the diversity of eukaryotic algae and cyanobacteria as well as an overview of the structure and function of lichen symbiosis. They know the groups of organisms involved in lichen symbiosis as well as important morphological and anatomical characteristics of lichens, algae and cyanobacteria and they are able to identify selected mid-European foliose lichen through their shape. The students have basic knowledge of the gas, water and mineral metabolism of lichens as well as basic knowledge of the diversity and function of the secondary metabolites produced by lichens (lichen substances). They acquire knowledge of habitat ecology, of the endangerment of lichens and of the indicators of air quality through lichens. The students have practical experience with the microscopic study of freshwater algae from different types of waters. They have an overview of current topics of phycology and are able to present a current topic from the literature.	**Workload:** Attendance time: 98 h Self-study time: 82 h
Courses:	
1. M.Biodiv.419-1 Biology of lichens (Lecture)	2 WLH
2. M.Biodiv.419-2 Current topics in phykology (Seminar)	1 WLH
3. M.Biodiv.419-3 Algae and lichens of the pre-Alps area (Excursion)	4 WLH
Examination: Written examination (60 minutes) **Examination prerequisites:** Oral presentation (max. 25 minutes) **Examination requirements:** Knowledge of the structure of lichen symbiosis and its ecology; overview of the diversity of foliose lichen and their role as an indicator for air quality: functions of lichen substances; endangerment of lichen biodiversity.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Thomas Friedl
Course frequency: jedes WiSe 419-1, 419-2; jedes SoSe 419-3	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.421: Plant ecology: Project course plant ecology**	6 C 8 WLH

Learning outcome, core skills: This module is meant for students who plan to write their master thesis on an ecological or vegetation scientific field. It is the aim of the module to impart the basics of scientific working, presenting and publishing in ecology. The module introduces to crucial aspects of experimental design, statistical analysis and graphical presentation of results as well as to the oral and written presentation of these results. The students acquire skills for scientific work in the field of plant ecology from the beginning of data analysis until the drafting of a scientific publication in English. Additionally, the oral presentation in English is practiced through presentation of a scientific paper.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses: **1. Basics of the design, realization and interpretation of ecological research projectsand basics of writing scientific publications** (Lecture)	 1 WLH
2. Scientific analysis and publication of plant ecological project data (Exercise)	7 WLH
Examination: Oral Presentation, mit schriftlicher Ausarbeitung in Form eines wissenschaftlichen Artikels basierend auf Projektdaten (max. 15 pages) **Examination requirements:** Knowledge of the essential aspects of scientific working in plant ecology from the experimental design to a publication.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dr. Dietrich Hertel
Course frequency: each winter semester; Blockveranstaltung	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.422: Plant ecology: Carbondioxide and water balance of trees**	6 C 8 WLH

Learning outcome, core skills: The students • have deepened knowledge of the theoretical basis of the gas exchange and water balance of plants and how these processes depend on the environment • have theoretical and practical knowledge of modern measuring techniques used in the field of tree ecophysiology • have deepened knowledge of how global warming affects the ecophysiology of trees • are able to measure the photosynthetic capacity, leaf conductance, xylem sap flux, leaf water status and the microclimate of old and young trees outdoors • have practical experiences in conducting ecophysiological and microclimatic measurements on the Göttingen Canopy Walkway within the new botanical garden • can differentiate functional types of various tree species • are able to present the results of measurements on the carbon and water balance of plants in accordance with scientific standards in written and oral form	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Carbondioxide and water balance of trees (Lecture)	2 WLH
2. Photosynthesis, respiration und transpiration (Exercise)	6 WLH

Examination: Minutes / Lab report (max. 10 pages) **Examination prerequisites:** Oral presentation (max. 25 minutes) **Examination requirements:** Knowledge of the ecophysiology of trees with focus on carbon and water balance. Basics of the gas exchange of plants, especially photosynthesis and respiration. Knowledge of transpiration and the role of plants in the “soil-plant-atmosphere” continuum. Knowledge of xylem sap flux, leaf conductance and the driving abiotic climatic and edaphic variables.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Christoph Leuschner
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.423: Plant ecology: Study of habitats**	6 C 8 WLH

Learning outcome, core skills:	**Workload:**
The students • learn the most important theoretical and methodical basics of the modern plant ecological study of habitat. Focus lies on European beech forest communities which are ecologically most important in Central Europe • get an overview of the scientific vegetation classification of beech forests and get to know important abiotic habitat factors such as microclimate and morphological and chemical soil characteristics • learn different techniques for the assessment of vegetation composition and for the analysis of various habitat factors using the example of beech forests of different habitats. Several parameters for the ecological characterization of soil conditions (e.g. morphological characterization of different soil horizons, determination of soil type) as well as various microclimate factors will be analyzed and related with the respective vegetation • get to know modern lab methods (ion emission spectrometry (ICP), gas chromatography, etc.) for the physicochemical analysis of soil samples (pH value, carbon and nitrogen contents, concentration of plant available cations). • get to know techniques for the electronic data analysis and subsequent scientific interpretation and presentation. The protocol covers a partial topic of the course. Core skills: scientific plant ecological field work and in the lab including written and oral presentation of results.	Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Plant ecology: study of habitats (Lecture)	2 WLH
2. Habitat ecology of various forest societies in the surroundings of Goettingen (Exercise)	6 WLH

Examination: Minutes / Lab report (max. 20 pages)	6 C
Examination prerequisites: Oral presentation (ca. 15 Min.) **Examination requirements:** Theoretical and methodical knowledge of modern plant ecological study of habitats with focus on beech forests in Central Europe. Scientific vegetation classification of beech forests as well as characterization of microclimatic, soil morphological and chemical properties.	

Admission requirements:	**Recommended previous knowledge:**
none	none
Language:	**Person responsible for module:**
English, German	Dr. Dietrich Hertel

Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.Biodiv.425: Evolution of embryophyta**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
The students get to know the current state of research in the field of the organismic evolution of embryophyta through study, presentation and discussion of latest case studies concerning speciation, history of evolution, chromosomal and genomic evolution, reproduction biology, evolution of traits and coevolution. They get an overview of novel theoretical and methodical research approaches to the comprehension of plant evolution. They acquire the ability to develop evolutionary hypotheses and are able to choose appropriate model systems and methods for their validation. The students acquire practical skills in presentation, interpretation and discussion of results (in scientific English). They are able to describe and understand evolutionary processes, hypotheses and methods and to give examples for case studies on terrestrial plants. They can discuss scientific results in English.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Speciation and evolution of land plants (Lecture) *Course frequency:* jedes Wintersemester	2 WLH
2. Plant systematics and phycology (Seminar) *Course frequency:* jedes Semester	2 WLH
Examination: Oral examination, zum Stoff der Vorlesung (approx. 15 minutes) **Examination prerequisites:** participation in the seminar and oral presentation (45 minutes) **Examination requirements:** In the oral examination the students demonstrate their ability to understand and discuss evolutionary processes and hypotheses as well as their knowledge of case studies on terrestrial plants. In the seminar the students shall give talks in scientific English and present research results – preferably those of their master thesis.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Elvira Hörandl
Course frequency: V: jedes Wintersemester, S: jedes Semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Biodiv.426: Reproduction and evolution of flowering plants**	6 C 4 WLH
Learning outcome, core skills: The students acquire intimate knowledge of the reproduction strategies and the developmental biology of flowering plants. They acquire a broad comprehension of the relevance of reproduction biology for the evolution and ecology pf plants, for general evolutionary biological problems (e.g. the paradox of sex) as well as for applications in plant breeding. Specific method skills for active research are acquired through experimental work, karyological and embryological analyses (experimental work, microscopic observation, seed flow cytometry) and statistical analyses. The students are able to answer questions concerning reproduction and developmental biology of plants and evolutionary biological hypotheses and know practical applications. They are able to plan, conduct and present scientific studies in the field of reproduction biology of plants.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Reproduction and evolution biology of flowering plants** (Exercise) **2. Reproduction strategies of flowering plants** (Lecture)	 3 WLH 1 WLH
Examination: Oral examination, zum Stoff der Vorlesung (approx. 15 minutes) **Examination prerequisites:** Protocol (max. 12 pages) **Examination requirements:** In the oral examination the students demonstrate their competences in reproduction and developmental biology of flowering plants, in evolutionary biological hypotheses and in practical applications. The protocol of the practical shows their skills to plan, conduct and present a scientific study in the field of reproduction biology of plants.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Elvira Hörandl
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.427: Molecular evolution of embryophyta**	6 C 4 WLH
Learning outcome, core skills: The students acquire a profound comprehension of the population genetics and molecular evolution of flowering plants. They acquire theoretical and practical knowledge of the application of molecular markers in plant systematics on the level of populations and species. They learn the specific lab techniques for the detection of both dominant and codominant molecular markers (Amplified Fragment Length Polymorphisms, microsatellites) and get to know the methodological proceedings in the primer design for non-model organisms. The students are able to gather and analyze molecular datasets of non-model organisms for land plants. The results are interpreted in the context of a specific evolutionary process and can be presented in a written protocol as well as in a talk. The students acquire skills in special methods and computer programs for data evaluation and interpretation (e.g. population genetic statistics, network analyses, offspring arrays).	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. DNA fingerprint techniques for terrestrial plants (Exercise)	3 WLH
2. Introduction to molecular markers (Lecture)	1 WLH
Examination: Oral presentation (ca. 15 minutes) und protocol (max. 12 pages) **Examination prerequisites:** Attendance of the lecture **Examination requirements:** In the protocol the students demonstrate their abilities in the acquisition and analysis of DNA fingerprint datasets of non-model organisms in land plants. They shall interpret their results in the context of specific evolutionary processes and give an oral presentation.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Diego Hojsgaard
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.430: Vegetation history: Project study in palaeoecology and palynology**	6 C 8 WLH

Learning outcome, core skills: Consolidation of pollen analytical or dendroecological/dendrochronological working methods, independent identification and documentation of pollen and spore types, preparation, presentation and analysis of palaeoecological data, use of software, induction into current palaeoecological topics. Independent problem and research oriented pollen analytical studies as part of a small research project in the field of vegetation history, dendroecology/dendrochronology or climate and environmental history as well as scientific examination of palaeoecological topics; written and oral presentation of results.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Current topics in palynology and climate dynamics (Seminar)	2 WLH
2. Palaeoecology and palynology (Exercise)	6 WLH

Examination: Minutes / Lab report (max. 10 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Knowledge of pollen and spore types; pollen analytical and dendrochronological working methods. Basics of dendrochronology and dendroecology and basics of the reconstruction of climate events in the Quaternary period based on pollen diagrams and dendrochronological series.	6 C

Admission requirements: Palynology/vegetation history/dendrochronology and/or pollen analytical exercises or an equivalent course.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hermann Behling
Course frequency: once a year	**Duration:** 2 semester[s]
Number of repeat examinations permitted: once	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Biodiv.431: Vegetation ecology: Applied vegetation ecology and multivariate analysis**	6 C 8 WLH

Learning outcome, core skills: Problem oriented project management, practicing methods of data collection and multivariate data analysis in vegetation ecology, vegetation sampling in grasslands, determination of plants even in their vegetative state, induction into current topics on the diversity and dynamics of grassland ecosystems. Gaining experience in the identification of vegetative and generative grassland plants, analysis and interpretation of multivariate data sets, ability to use software for the input and processing of vegetation ecological data and for ordination, studying in small groups and individually, preparation and presentation of posters, written presentation of scientific problems and results.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Lecture "Basics and methods of data collection and multivariate data analysis in vegetation ecology" (Lecture)	2 WLH
2. Exercise "Grassland vegetation and multivariate vegetation analysis"	6 WLH

Examination: Minutes / Lab report (max. 15 pages) **Examination prerequisites:** Poster presentation	6 C

Examination requirements: Knowledge of vegetation ecological data collection and multivariate data analysis. Assessment and classification of grassland vegetation . Knowledge of current vegetation ecological topics on the diversity and dynamics of grassland ecosystems. Presentation of results in the form of a scientific publication.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Erwin Bergmeier
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.437: Vegetation history: Methods in palaeoecology**	6 C 8 WLH
Learning outcome, core skills: The students learn various palaeoecological methods: analysis of annual rings, charcoal, algae, diatoms, ostracods, dinoflagellates, non-pollen palynomorphs (NPPs), amoebae, sediment parameters etc.. They acquire knowledge of different palaeoecological parameters regarding environment, vegetation, climate and human settlement history and their evaluation in the context of the global change research. They learn presentation and analysis methods and how to use modern software. The students get to know the broadness of possible applications using examples from current palaeoecological topics. Skills for the assessment of applications of palaeoecological analyses during environmental, vegetation and climate historical as well as archaeological studies. Independent realization of small problem and research oriented palaeoecological studies in the field of environmental, vegetation or climate history. Scientific examination of palaeoecological topics from global change research, presentation of results.	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses:	
1. Methods in palaeoecology (Lecture)	1 WLH
2. Methods in palaeoecology (Exercise)	5 WLH
3. Current research results in palaeoecology and palynology (Seminar)	2 WLH
Examination: Lecture (approx. 20 minutes) **Examination requirements:** Presentation of results of a practical work.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hermann Behling
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.Biodiv.441: Animal ecology: Evolutionary ecology	6 C 8 WLH
Learning outcome, core skills: The students learn basic techniques for the analysis of phylogenetic relations. Armored mites (Oribatida, Chelicerata) with possible Precambrian origin serve as a model group. Phylogenetic relations and biogeographical distribution patterns are analyzed by means of various molecular markers (18S rDNA, 28S rDNA, elongation factor 1 alpha, cytochrome oxidase I). In addition, the age of various taxa of armored mites is studied. Besides phylogenetic and biogeographical patterns the intraspecific variance of sexual and parthenogenetic species of armored mites which presumably survived for hundreds of millions of years is analyzed. The programs used for the analyses include PAUP*, RAxML, MrBayes, BEAST, Bioedit, Clustal X and Treeview. Basid knowledge of molecular biology and bioinformatics is helpful but not mandatory to attend this course. **Core skills:** Modern techniques and procedures including statistical analyses for the discovery of phylogenetic relations and biogeographical distribution patterns of animal groups. Knowledge of the intraspecific variance of sexual and parthenogenetic species.	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses:	
1. Evolutionary ecology (Lecture)	2 WLH
2. Evolutionary ecology - experiments (Exercise)	6 WLH
Examination: Minutes / Lab report (max. 15 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Knowledge of phylogenetic relations and biogeographical distribution patterns of animal groups using the example of armored mites. Phylogenetic dating of animal species and determination of the intraspecific variance of sexual and parthenogenetic species.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Mark Maraun
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.442: Animal ecology: Synecology of animals**	6 C 8 WLH
Learning outcome, core skills: The students learn: • the collection and statistical analysis of data for animal communities from different habitats (forests, meadows); selected animal groups (earthworms, spiders, ground beetles, rove beetles, springtails and mites) are classified and counted. Environment and vegetation data are collected for each habitat and the relations between the distribution of species and the environmental conditions are analyzed • the determination of density, biomass and diversity of animal groups using different techniques (soil traps, heat extraction, insect vacuum) • statistical methods (analysis of variance, discriminant analysis and canonical correspondence analysis) for the analysis of the composition of animal communities from different habitats and its relations with environmental factors • the preparation of a scientific publication using the obtained data • the oral presentation of scientific data and perceptions • methods for the assessment of the ground-dwelling and above-ground fauna • knowledge of statistical procedures for the analysis of animal communities • analysis of control quantities of animal communities (abiotic and biotic factors) • knowledge of the nutritive organization of animal communities	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses: **1. Synecology of Animals** (Lecture) **2. Synecology of Animals - Experiments** (Exercise)	 2 WLH 6 WLH
Examination: Minutes / Lab report (max. 15 pages) **Examination prerequisites:** Oral presentation (ca. 15 min.) **Examination requirements:** Knowledge of indigenous animal communities of forests and meadows (especially arthropods, clitellates, insects etc. that live at or in the ground) and their ecological requirements in the respective biotopes. Methods for the quantification of animal communities and their dependence on environmental parameters.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Mark Maraun
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.445: Animal ecology: Molecular analysis of trophic interactions in soil food webs**	6 C 8 WLH
Learning outcome, core skills: The students learn: • Techniques for the molecular analysis of tropic interactions in soil food webs. The prey spectra of ground-dwelling arthropods (collembolans, mites) from forests are determined by using PCR based gut content analysis with specific DNA markers. • Design and realization of laboratory feeding experiments. • Methods of field sampling of soil animals, DNA extraction, PCR, gel electrophoresis, capillary electrophoresis, lipid analysis. • Statistical analysis with R. Core skills: Theoretical and practical knowledge on the structure of food webs and trophic interactions. Structure of soil animal communities.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Molecular analysis of trophic interactions in soil food webs - experiments (Exercise)	6 WLH
2. Molecular analysis of trophic interactions in soil food webs (Lecture)	2 WLH

Examination: Minutes / Lab report (max. 15 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Protocol	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in molecular biology
Language: English, German	**Person responsible for module:** Dr. rer. nat. Olaf Butenschön Prof. Dr. Stefan Scheu
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: once	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.446: Molecular zoology and insect-biotechnology**	6 C 8 WLH
Learning outcome, core skills: The module addresses students who want to acquire profound theoretical and practical knowledge of molecular genetic approaches. Relevant methods and experimental design are imparted theoretically and practically. Selected topics of molecular zoology are profoundly covered in the lectures based current publications. Current molecular approaches in pest control and insect biotechnology are covered as well. Learning outcome: • Application of various molecular biological techniques, experimental strategies and interpretation of data • Gene function analysis in Zoology: How are relevant genes identified and how is their function studied in model and non-model organisms? (e.g. genetic screens, reverse genetics (RNAi), genome editing (CRISPR/Cas9), transgenesis) • Knowledge of databases of DNA, protein and gene function • Identification of orthologous genes in different species • Establishment of new molecular genetic model systems for zoological questions • Advanced discussion of current research topics in molecular zoology • Advanced discussion of most recent approaches in insect biotechnology using molecular genetic methods (i.a. pest control). Core skills: The students should be able to • Design strategies for the identification and analysis of gene functions in non-model organisms • Design the establishment of new molecular genetic model systems • Present and assess scientific problems concerning selected topics of molecular Zoology.	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses:	
1. Molekulare Zoologie und Insekten-Biotechnologie (Lecture) *Contents*: molecular genetic methods; gene fuction analysis; selected topics from molecular zoology; most recent developments in insect biotechnology	2 WLH
2. Topics of molecular zoology and insect biotechnology (Seminar)	2 WLH
3. Molecular zoology and insect biotechnology (Exercise)	4 WLH
Examination: Written examination (60 minutes) **Examination prerequisites:** Regular participation in the seminar and oral presentation	6 C
Examination requirements: The students should be able to apply the contents and methods listed as “core skills” to new questions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ernst A. Wimmer Prof. Dr. Gregor Bucher
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.Biodiv.450: Plant ecology: Impact of global climate change on plant communities and their functional traits**	6 C 8 WLH
Learning outcome, core skills: The students • have profound knowledge of interactions between plants • have an overview of completion research • understand the concept of “functional traits” of species and communities • are able to analyze the reaction of plants to the main factors of global climate change experimentally • have profound knowledge of the design and statistical (variance analytical) analysis of ecological experiments • are able to present the results of ecological experiments in accordance with scientific standards in written and oral form.	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses:	
1. Impact of global climate change on plant communities (Lecture)	2 WLH
2. Impact of global climate change on plant communities (Exercise)	6 WLH
Examination: Minutes / Lab report (max. 10 pages) **Examination prerequisites:** Oral presentation (max. 25 minutes) **Examination requirements:** Knowledge of plant interactions and of the concept of “functional traits”. Knowledge of experimental methods and statistical procedures in botanical (population) ecology. Knowledge of strategies for the adaption of plants to climate change.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Christoph Leuschner Dr. Ina Meier
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.480: Nature conservation biology: Nature conservation inventories**	6 C 8 WLH
Learning outcome, core skills: A valid, objective and reliable provision of data for preparing and making decisions is indispensable for an adaptive management in nature conservation. Strategic and operational nature conservation design, the realization of nature conservation measures as well as the controlling in nature conservation depend crucially on the quality of the available data. Introductory, the students learn various inventory procedures used in practical nature conservation, use them to collect data in a small model area and evaluate the methods concerning the validity, objectivity and reliability of the results of their inventory. Subsequently, the students get to know inventory procedures with lower risk and less error from the design over the realization to the processing and analysis of data using the same model area. The available data pool comprises time series from a multi-year monitoring that the students complement for specific areas and time points. The lecture covers both the theoretical background and approaches and examples for nature conservation inventories on different spatial and content-related levels. Learning objective of the module are the development • of skills for the critical analysis and evaluation of data stocks and inventory methods in nature conservation • of skills to plan, realize and analyze goal-oriented and statistically validated nature conservation inventories • of skills to use geographic information systems, databanks and statistics during nature conservation inventories • of skills to map habitats and species (use of remote sensing, GPS, laser rangefinder and other equipment as well as selected methods such as plot sampling, plotless sampling and distance sampling) The module shall impart skills to • understand, structure and realize planning-related processes • systematically question and critically evaluate information that serves as the basis for decision-making in the light of the projected outcome • develop and realize objective, reliable and valid study and inventory designs • deposit, manage and statistically process obtained information in spread sheets, databanks and geographical information systems • apply statistical procedures – especially from the non-parametric section – in inventory design and data analysis	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses: **1. Nature conservation inventories** (Lecture) **2. Nature conservation inventories** (Exercise)	 2 WLH 6 WLH

Examination: Minutes / Lab report (max. 20 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Strategic and operational nature conservation design, realization of nature conservation measures and controlling. Knowledge concerning the evaluation of data stocks and inventory methods in nature conservation. Knowledge of GIS, databanks and statistics for nature conservation inventories.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dr. rer. nat. Hermann Hondong
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 7	

Additional notes and regulations:

Course in summer semester: in German; max.12 students;

course in winter semester (together with MINC): in English, max. 7 students

Georg-August-Universität Göttingen **Module M.Biodiv.481: Nature conservation biology: Population biology in nature conservation**	6 C 8 WLH

Learning outcome, core skills: Study of the methodology of an endangerment analysis (population viability analysis, PVA) of an animal species (case study partridge). The students determine causes of endangerment and develop options for the nature conservation in the cultural landscape. The students transfer empirically collected own data and data from the literature to a population model and develop a modeling of an endangered animal population. Core skills: collection and analysis of field data; use of population models; development of management options for an endangered animal species; knowledge of the telemetry as an important method for the registration of movement patterns of vertebrates.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Population viability analysis (Lecture)	2 WLH
2. Population viability analysis (Exercise)	6 WLH

Examination: Minutes / Lab report (max. 20 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Knowledge of the potential endangerment of specific animal species and measures for their protection in the cultural landscape. Modeling of endangered animal populations.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. Eckhard Gottschalk
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.483: Nature conservation biology: Assessment of wildlife species for nature conservation**	6 C 8 WLH

Learning outcome, core skills: Monitoring populations of endangered species is an essential component of adaptive conservation management. With completion of this course students should be able to design surveys which allow accurate and reliable population estimations. In the course of the module the theoretical basis for quantitative assessments are imparted and practical experiences on design and realization of wildlife surveys are presented. In the tutorial part of the course population data are being analyzed and interpreted. An understanding of concepts such as effective strip width, cluster size, encounter rate and detection probability as well as the influence of these variables on population estimates and associated variance is being provided.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Theoretical background of population assessment (Lecture)	2 WLH
2. Analysis, interpretation and management of stand data (Exercise)	6 WLH

Examination: Minutes / Lab report (max. 20 pages) **Examination prerequisites:** Oral presentation (ca. 15 minutes) **Examination requirements:** Basics of adaptive conservation management and knowledge of the realization of wildlife surveys. Basics on survey design and practice-oriented estimation of wildlife populations.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** PD Dr. rer. nat. Matthias Waltert
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.488: Nature conservation biology: Ornithology**	6 C 8 WLH

Learning outcome, core skills:	**Workload:**
The students acquire knowledge concerning the biology and biodiversity of indigenous bird species and their habitats. To these belongs knowledge of habitat conditions, feeding ecology, breeding biology, hibernation, population trends and causes of endangerment. The students learn the optical and acoustic identifications of bird species within the open country by use of selected ornithological methods: telemetry, mapping, analysis of the habitat use of individual species and generation of species profiles. The students acquire skills for the comparison of different landscape elements regarding their avifauna, for the analysis of collected data and for the modeling of the extinction risk of endangered populations. Core skills: knowledge of the biodiversity of the indigenous avifauna and its ecology as well as of field methods for its quantitative registration, statistical analysis and evaluation of the endangerment potential on species and population level.	Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Biology of selected bird species (Lecture)	2 WLH
2. Identification of birds in the field and methods in ornithology (Exercise)	6 WLH
Examination: Minutes / Lab report (max. 20 pages) **Examination requirements:** Biodiversity of the indigenous avifauna as well as of field methods for its identification and evaluation of the endangerment potential on species and population level.	6 C

Admission requirements: none	**Recommended previous knowledge:** Knowledge of the songs of the most common bird species.
Language: English	**Person responsible for module:** Dr. rer. nat. Eckhard Gottschalk
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Biodiv.491: Next generation sequencing for evolutionary biology**	6 C 4 WLH
Learning outcome, core skills: The students acquire knowledge of the various systems and techniques for "next generation sequencing". The focus of the module lies on the fast developing field of bioinformatics and data analysis. Lab methods are explained and discussed. The students learn the different possible applications for "next generation sequencing" data in evolutionary biology of animals and plants, for example biodiversity, evolution of traits, adaption, phylogeography, population genetics, hybridization, genotyping and QTL (quantitative trait locus) analyses. They get an overview of the theory and gain practical experiences in this new research area. They acquire the competence to choose suitable methods for evolutionary questions and to test hypotheses on non-model organisms. The students are able to list the differences and (dis)advantages of various "next generation sequencing" methods and to select suitable methods to analyze specific evolutionary questions by use of non-model organisms. They are able to compare and analyze the raw data of "next generation sequencing" and to annotate genes of a compared genome or transcriptome. The students shall present and discuss case studies from the field of "next generation sequencing" during the seminar in scientific English.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. M.Biodiv.491-2 Next generation sequencing: examples of botanical and zoological studies (Seminar)	0,5 WLH
2. M.Biodiv.491-3 Analysis of next generation sequencing data (Exercise)	3 WLH
3. M.Biodiv.491-1 Next generation sequencing: methods, data analysis and applications (Lecture)	0,5 WLH
Examination: Minutes / Lab report (max. 12 pages) **Examination prerequisites:** Oral presentation (max. 20 min.) **Examination requirements:** Knowledge of the various applications of „next generation sequencing" in evolutionary biology of animals and plants. Overview of the theory and practical experiences in this new research area.	6 C

Admission requirements: none	**Recommended previous knowledge:** Speciation and evolution of land plants (Lecture: M.Biodiv.425). Basic knowledge about programs that deal with DNA conting assembly and multiple sequence alignment (e.g. Geneious) are advantageous
Language: English	**Person responsible for module:** Dr. Marc Appelhans

Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Che.1315: Chemical Dynamics at Surfaces**	6 C 4 WLH
Learning outcome, core skills: The students of this module will achieve a deeper theoretical knowledge of chemical dynamics on surfaces as well as their influence on other fields in natural science, in order that they will be able to approach and solve problems regarding the quantitative questions in this field.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture Combined with Tutorial: Chemical Dynamics at Surfaces	
Examination: Written examination (180 minutes) **Examination prerequisites:** Active participation in provided tutorial	6 C
Examination requirements: By Understanding and solving exemplary questions regarding this research field with the help of limited reference material in predetermined time will count as minimum 50 % of the required score	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Alec Wodtke
Course frequency: normally every 2 years	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 2
Maximum number of students: 64	

Georg-August-Universität Göttingen **Module M.Cp.0004: Plant diseases and pests in temperate climate zones**	6 C 4 WLH

Learning outcome, core skills: Students will be able to recognize and identify the main pests and diseases, understand the origin, distribution and dynamics of diseases and pests in the field as a basis for the development of control methods.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Plant Diseases and Pests in Temperate Climate Zones (Lecture, Excursion, Exercise) *Contents*: The main diseases and pests (fungi, viruses, bacteria, nematodes, mites, and insects) of crops (arable crops, vegetables, fruit crops) in temperate climate zones will be presented. The symptoms, diagnosis, biology and life cycles, economic importance, possible control methods will be studied in lectures, practicals and field trips. The economic damage, prognosis, possible control methods using economic thresholds will be presented.	4 WLH
Examination: Written examination (45 minutes) **Examination prerequisites:** regular attendance at field practical and excursion **Examination requirements:** Identification and diagnosis of plant pests and diseases of crops of the temperate climate zones, knowledge of the life cycle, distribution, and population dynamics.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Birger Koopmann
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0005: Integrated management of pests and diseases**	6 C 4 WLH
Learning outcome, core skills: Students will be able to understand and develop plant protection strategies to control plant pathogens and insect pests while observing the sustainability of the whole crop production system.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Integrated Management of Pests and Diseases (Lecture) *Contents*: The integrated pest management concept and its main components are presented with regard to the management of fungal plant pathogens and insect pests in temperate zones: preventive methods, selective use pesticides, effect of cultural methods (sowing date, soil preparation, fertilization, crop rotation, varieties) on occurrence, distribution and damage of plant pathogens and insect pests.The diagnostics and quantification of damage symptoms; prognosis systems are discussed.	4 WLH
Examination: Oral examination (approx. 20 minutes) **Examination requirements:** Knowledge of the relationship between crop production methods and the occurrence of plant diseases and insect pests in temperate zones, concept of integrated pest management.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Andreas von Tiedemann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0006: Pesticides I: Mode of action and application techniques, resistance to pesticides**	6 C 4 WLH
Learning outcome, core skills: Students will know the pesticide compounds used in agriculture, their mode of action, application techniques and understand the development of resistance and resistance management strategies.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Pesticides I: Mode of Action and Application Techniques, Resistance to Pesticides (Lecture, Excursion) *Contents*: Mode of action and application techniques of plant protection products (fungicides, insecticides, acaricides, herbicides), the characeristics of active ingredients are presented. Technical and technological possibilities of modern crop protection, requirements and pesticide resistance management is discussed.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of pesticides, their mode of action, targets, side effects, application techniques; important factors for resistance development and possibilities for prevention and reduction.	6 C

Admission requirements: Only for students from the study programme "Crop Protection" and "Sustainable International Agriculture"	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Andreas von Tiedemann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0007: Pesticides II: Toxicology, Ecotoxicology, Environmental Metabolism, Regulation and Registration**	6 C 4 WLH
Learning outcome, core skills: Students will understand the basic and applied pesticide toxicology and ecotoxicology, the development of pesticides and risk assessment, and the regularory framework of pesticide registration and pesticide risks (Germany, EU)	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Pesticides II: Toxicology, Ecotoxicology, Environmental Metabolism, Regulation and Registration (Lecture) *Contents*: This unique module gives an overview of all aspects of pesticide science, presented by Several lecturers, being specialists. Basic and applied toxicology of pesticides , ecotoxicology of pesticides, environmental fate and metabolism of compounds in different environments, development of pesticides, regulation of pesticide use and registration.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of the toxicology of pesticides, ecotoxicology, fate and metabolism in the environment, regulation and registration of pesticides in Germany and the EU.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Andreas von Tiedemann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 3
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0010: Plant pathology and plant protection seminar**	3 C 2 WLH

Learning outcome, core skills: Students will learn, to present, discuss and defend their own individual research project. They will be able to critically discuss scientific results and provide suggestions for improvement.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Plant Pathology and Plant Protection Seminar (Seminar) *Contents*: In this seminar scientific projects, targets of research and results of research projects will be presented and discussed by the MSc students and members of the research staff. Techniques of presentation and the ability to critically review and discuss research results will be practiced which will suggest and lead to new thoughts for further research projects. *Course frequency:* jedes Wintersemester	4 WLH
Examination: Presentation (ca. 20 minutes) **Examination prerequisites:** Participation in 12 seminars **Examination requirements:** Very good knowledge of own area of research and good ways of presentation of own results. Participation in discussion.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Andreas von Tiedemann
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0011: Agricultural entomology seminar**	3 C 2 WLH

Learning outcome, core skills: Students will learn, to present, discuss and defend their own individual research project. They will be able to critically discuss scientific results and provide suggestions for improvement.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Agricultural Entomology Seminar (Seminar) *Contents*: In this seminar scientific projects, targets of research and results of research projects in Agricultural Entomology will be presented and discussed by the MSc students. Techniques of presentation and the ability to critically review and discuss research results will be practiced which will suggest and lead to new thoughts for further research projects.	2 WLH
Examination: Presentation (ca. 20 minutes) **Examination prerequisites:** Participation in 12 seminars **Examination requirements:** Very good knowledge of own area of research and good ways of presentation of own results. Participation in discussion.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Vidal
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.Cp.0012: Weed biology and weed management	6 C 4 WLH
Learning outcome, core skills: Knowledge of the main weed species, their characteristics, ecology, competition and damage. Students will understand the dynamics and parameters of weed populations. Knowledge of weed control methods, their possibilities and limitations. Students will be able to formulate criteria for selecting suitable weed management techniques. They will know how to theoretically work on a topic in weed science and understand international aspects of weed dissemination, populations and weed management.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Weed Biology and Weed Management (Lecture) *Contents*: The module deals with the biology of weeds and management of weed populations. The botanical weed characteristics and population biology will be presented. Important weeds of Europe and other parts of the world will be presented and the damage caused discussed. Different methods of control are presented: chemical, physical control as well as preventive cultural methods. Actual problems in crop production caused by weeds are discussed. Legal and international aspects of weed dissemination, damage caused and methods of control will be discussed. In the seminar part students will present recent research projects and discuss these in context with the topics presented in the lecture.	4 WLH
Examination: Oral examination (ca. 20 minutes,67%) and Presentation (ca. 20 minutes,33%) **Examination prerequisites:** Oral presentation **Examination requirements:** Basic knowledge of weed characteristics, biology and ecology. Knowledge of the main weed control techniques, mode of action and examples. Knowledge of the main weeds worldwide and ways of management. Ability to associate weed populations with present crop production systems and develop control strategies.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Horst-Henning Steinmann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Cp.0013: Applied weed science	6 C 4 WLH
Learning outcome, core skills: Knowledge of the main weed species, their characteristics, ecology, competition and damage. Students will be able to identify the main weed species. Understanding weed population dynamics. Knowledge of possibilities and limitations of weed control. Knowledge of the mode of action of chemical and non chemical weed control. Students will be able to diagnose and explain weed problems in the field and develop problem solving competences.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Weeds and Herbicides/Applied Weed Science (Lecture) *Contents*: The module deals with practical aspects of weed biology and weed management strategies. The botanical weed characteristics will be presented in the field and in the greenhouse. The main weeds species of Europe and their characteristics for identification will be studied. Weed management strategies in use today and difficulties in weed control will be shown and discussed on field trips. In the practical students will prepare a herbarium of weeds collected in the field.	4 WLH
Examination: Oral examination (ca. 20 minutes, 66%), written paper (max. 10 pages, 34%) **Examination prerequisites:** Participation in the practical and excursions, preparation of a herbarium. **Examination requirements:** Basic knowledge of the main weed species and characteristics for identification. Knowledge of the mode of action of the main control methods including examples. Ability to recognize weed populations of respective crop production systems in the field and to develop control strategies. Preparation of a written paper (excursion or practical protocol) and a herbarium.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Horst-Henning Steinmann
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Cp.0014: Plant Nutrition and Plant Health**	3 C 2 WLH

Learning outcome, core skills: Understanding the relationship between plant nutrition and plant health and its significance in the value-added food chain.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Plant Nutrition and Plant Health (Lecture, Seminar) *Contents*: Nutrient uptake and transport in the plant; function of different nutrients in the plant especially with respect to plant health (susceptibility, tolerance, resistance); mechanisms to increase the efficiency of nutrient availability, uptake and use; characteristics of plant health, effect of nutrient imbalances on plant metabolism and development of plant harvest products, the nutrient concentrations and processing quality.	2 WLH
Examination: Written exam (90 minutes) **Examination requirements:** Knowledge of and ability to present the presented topics in their context: development of nutritional and processing quality in different crop plants; quality requirements and ways of realization by crop production methods.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Klaus Dittert
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.Cp.0015: Molecular weed science**	6 C 4 WLH
Learning outcome, core skills: Understanding the basic principles of the interactions between herbicides and the target plant and herbicide selectivity. Resistance mechanisms in weeds and mechanisms of tolerance in cultivated plants are understood, can be distinguished and practical consequences be drawn. Students have a fundamental understanding of the development and distribution of herbicide resistance in weeds.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Molecular Weed Science (Lecture, Practical course) *Contents*: Lecture: In the lecture the application of molecular methods in weed science and weed management is presented, focusing on the naturally occurring herbicide resistance in weeds. The genetic basis will be taught with regard to transgenic and non transgenic herbicide tolerance in cultivated plants. The possibilities of the use of molecular techniques for the detection of herbicide resistance in weeds will be discussed. New findings by the so called –omics (genomics, proteomics and metabolomics) on the interaction of weeds with their environment are of importance in the development of new herbicides and will be discussed as well as alternative transgenic approaches in weed management. Practical: A one week practical will be held after the lecture. In the practical actual resistance problems in weeds are presented. Resistance detection methods will be presented and carried out on the protein level (target assay) and on the genetic level (SNP-analysis') and the possible use for a sustainable herbicide weed management will be discussed.	4 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Participation I the laboratory practical **Examination requirements:** Knowledge of the interaction between herbicide and target, the selectivity of herbicides, mechanisms of resistance in weeds, mechanisms of development of tolerance in cultivated plants. Basic knowledge of development and distribution of herbicide resistance in weeds	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Jean Wagner
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

20	

Georg-August-Universität Göttingen **Module M.Cp.0016: Practical statistics and experimental design in agriculture**	6 C 4 WLH
Learning outcome, core skills: The aim of the course is to familiarize students with the basic concepts of statistics and their application in agricultural science. The second goal is to learn the use of software packages like SAS.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Practical Statistics and Experimental Design in Agriculture (Lecture, Exercise) *Contents*: In the beginning of the course, students are introduced to the basic concepts of statistics like frequency distributions, the normal distribution and hypothesis testing. They are also introduced to software packages like SAS, that are used for the practical exercises. Regression and correlation analysis are then introduced. Different experimental designs like randomized block, latin square, and split plot are described and analyzed by one-way analysis of variance or as factorial experiments. Generalized Linear Models will be used and multivariate data will by analyzed by cluster and principal component methods. A large amount of examples and exercises constitute an important aspect of the course, enabling the students to understand and assimilate the theoretical content. Practical analyses of example data sets also provide the students with the required experience and skills for future statistical tasks in the context of Mastertheses.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of the basic concepts of statistics and their application in agricultural science and in the use of software packages like SAS.	6 C

Admission requirements: none	**Recommended previous knowledge:** Mathematics, statistics
Language: English	**Person responsible for module:** Prof. Dr. Heiko C. Becker
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 3
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.EP.015a: Peer-to-Peer Assistantship in Anglophone Literature and Culture**	6 C
Learning outcome, core skills: Advanced students revise basic knowledge of literary and cultural theories and deepen their understanding by explaining and critically discussing them with other students. They reflect on possible approaches in literary analysis[BS1] . They revise basic knowledge of academic writing and deepen it by explaining several features, e.g. bibliography, research paper, methodological chapters, to other students, providing guidance for each other.	**Workload:** Attendance time: 0 h Self-study time: 180 h
Course: Peer-to-peer meetings *Contents*: The student tutors one up to three first-semester master student(s) in literary and cultural courses with a special focus on the understanding and usage of literary and cultural theories under academic aspects. The sessions take place regularly upon consultation, at least 6 times during the semester. The mentoring is supervised by a lecturer of the department.	
Examination: Learning journal (max. 3500 words), not graded **Examination requirements:** Proof of at least 6 regular meetings with the assigned mentees. Proof of counselling on the following areas: Understanding of literary and theoretical texts; working with secondary literature; applying theoretical frameworks to a text/texts of a certain topic; feedback about approaches. Reflecting on learning progress of mentees.	6 C

Admission requirements: Obligatory counselling with lecturer of the theory-based lecture in module M.EP.01c to prove a high-enough level of knowledge of theories and approaches.	**Recommended previous knowledge:** Successful attendance of a master module finishing with a term paper in Anglophone literary and cultural studies; successful attendance of mentoring training.
Language: English	**Person responsible for module:** Dr. Frauke Reitemeier
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 7	

Additional notes and regulations: The aim of this module is to assist first-semester master students to understand the methods and mindsets of the British Literature and Culture department through peer-to-peer mentoring.

Georg-August-Universität Göttingen Module M.EP.01a: Anglophone Literature and Culture	6 C 2 WLH
Learning outcome, core skills: • To deepen and consolidate the content and methodology of literature and cultural studies previously acquired in the BA programme in British Studies. • A competency of synergetic use of literature and cultural studies methodologies through the combination of diachronic and synchronic approaches in the courses listed below.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Lectures on English literature and Cultural Studies**	2 WLH
2. Independent Study on British Cultural Studies *Contents*: For the Independent Study portion of the module the instructor will suggest a thematically focused research topic for theory- and method-based self study. The student will make use of relevant research methods, primary and secondary sources, and outline potential theses which result from scholarly dialogue with the instructor. Students will develop the competence to work independently and scientifically, and thereby learn to reflect critically upon their work. During this part, which consists of 60 hours of the 124 hours of self study required in total, students will deepen their methodological competency and theoretical knowledge. Instruction will take place during the instructor's office hours; the assessment of progress during the semester will be done by means of an ungraded portfolio.	
Examination: Final Written Exam (90 min.) or Oral Exam (20 min.) **Examination prerequisites:** Regular active participation with no more than two excused absences (in case Independent Study is not selected); for an Independent Study, three meetings with the instructor are required.	
Examination requirements: • basic knowledge of a literature- and cultural-history epoch • a secure survey- and contextual knowledge of the topics, texts and literature- and cultural history methods worked on in the lectures	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen **Module M.EP.01b: North American Literature and Culture**	6 C 4 WLH
Learning outcome, core skills: • To broaden and consolidate the content and methodology of literature and cultural studies previously acquired in the BA program in North American Studies. • A competency of synergetic use of literature and cultural studies methodologies through the combination of diachronic and synchronic approaches in literature or lectures on literary-, cultural-, or media- theory and "Advanced American Cultural History and Rhetoric."	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lectures on American literature and cultural studies, or lectures on literary, cultural, or media theory (Lecture)	2 WLH
Course: Cultural Studies Seminar "Advanced American Cultural History and Rhetoric" (Seminar)	2 WLH
Examination: 2 Take-home exams (ca 2000 words each; max. 4000 words) **Examination prerequisites:** Regular active participation with no more than two excused absences.	6 C
Examination requirements: Basic knowledge and application of themes and texts from the lectures.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 80	

Georg-August-Universität Göttingen **Module M.EP.01c: Anglophone Literature and Culture: Theoretical Foundations**	12 C 5 WLH
Learning outcome, core skills: • Deepening of basic knowledge of Anglophone history of literature from the Renaissance to the present • Deepening and broadening of knowledge of literary and cultural theory • Competence of independent critical comparative analysis of core texts by applying appropriate theories • Competence of critically reflection on epochal and thematic developments of Anglophone literature and cultural history.	**Workload:** Attendance time: 84 h Self-study time: 276 h
Courses: **1. Lecture on Anglophone literature and cultural history**	 2 WLH
2. Course on literature and cultural theory	2 WLH
3. Tutorial or self-study	1 WLH
Examination: Learning journal (max. 5000 words) **Examination prerequisites:** Regular active participation with no more than two excused absences. **Examination requirements:** The exam is taken in the course on literature and cultural theory.	12 C
Examination requirements: Students must demonstrate that they • have a basic knowledge of an epoch or a thematic area of Anglophone literature and cultural history • can critically reflect and comment on this basic knowledge • have a basic knowledge of literary and cultural theories • can apply this knowledge to a text, topic, or genre within an epoch of Anglophone literature and cultural history	

Admission requirements: Obligatory Advisement	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: not limited	

Additional notes and regulations:

This module is designed for students with little knowledge of the areas of the theory-based literature analysis and literary and cultural theory.

Georg-August-Universität Göttingen Module M.EP.020: English Linguistics (A)	6 C 2 WLH
Learning outcome, core skills: • Deepening and broadening of BA-level linguistic knowledge and competence with regard to speech systems (phonology, morphology, syntax, semantics) and linguistic usage (pragmatics, socio-linguistics, psycho-linguistics) • Ability to apply linguistic methods and hypotheses in key fields of research in modern linguistics • Knowledge of and ability to critically analyze strategies of argumentation as well as make structured description of linguistic content.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Course on basic knowledge of English linguistics**	2 WLH
2. Independent Study on topics of advanced linguistics *Contents*: The qualification goals are: a) competence in developing specialized theoretical statements from research publications; b) competence in corresponding and correct application of linguistic theories on given speech phenomena in the prescribed field of study; c) advanced knowledge of the subject, as necessary for meaningful class participation, and as is necessary to acquire if not present prior to the beginning of the course. Independent studies comprise 75 hours of the total self-study and will generally require a minimum of three meetings with the instructor during the semester. Progress will be assessed in interviews and/or through written assignments, subject to prior agreement.	
Examination: Written examination (90 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Examination requirements: The students must demonstrate knowledge of the structural units and structural relationships of English, mastery of linguistic methods of analysis, and be able to give a structured representation of linguistics.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students:	

80	

Additional notes and regulations: This module is designed exclusively for students with a basic knowledge of linguistics. This course cannot be taken if you have already taken or plan to take Module M.EP.021.

Georg-August-Universität Göttingen **Module M.EP.021: English Linguistics (B)**	6 C 4 WLH

Learning outcome, core skills: • Deepening and broadening of BA-level linguistic knowledge and competence with regard to speech systems (phonology, morphology, syntax, semantics) and linguistic usage (pragmatics, socio-linguistics, psycho-linguistics) • Ability to apply linguistic methods and hypotheses in key fields of research in modern linguistics • Knowledge of and ability to critically analyze strategies of argumentation as well as make structured description of linguistic content.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Course: "English Linguistics: An Overview"	2 WLH
2. Main Seminar: Advanced Linguistics	2 WLH
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused absences.	

Examination requirements: Demonstration of the ability to research and absorb relevant research on a linguistics-relevant subject, to extract relevant research questions, to analyze differentiated linguistic objects, and to select and evaluate an appropriate theory.	

Admission requirements: none	**Recommended previous knowledge:** Fundierte sprachwissenschaftliche Vorkenntnisse
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 80	

Additional notes and regulations: This module is designed for students with an advanced knowledge of linguistics. This course cannot be taken if you have already taken or plan to take Module M.EP.020.

Georg-August-Universität Göttingen **Module M.EP.021 (AS): Linguistics (Advanced)**	8 C 4 WLH

Learning outcome, core skills: This module aims at students with a basic knowledge of linguistics. Students consolidate and expand on their knowledge of English linguistics concerning linguistics and their competences concerning the language system (mainly semantics) and the linguistic usage (pragmatics, sociolinguistics, psycholinguistics), as acquired in the bachelor programme. They learn to apply linguistic methods and hypotheses in modern linguistics' core field of research. They become acquainted with argumentation strategies and learn how to critically analyze them. They learn how to present linguistic contents in a well-structured manner.	**Workload:** Attendance time: 56 h Self-study time: 184 h

Courses:	
1. Course "English Linguistics: An Overview"	2 WLH
2. Linguistic advanced seminar	2 WLH

Examination: Presentation (approx. 20 min.) and written assignment (approx. 6000 words)	8 C

Examination requirements: Students have to prove their ability to find research literature which is relevant for linguistically relevant subjects, to extract the relevant research questions, to scrupulously analyze the linguistic item, and to choose and evaluate an appropriate theory.	

Admission requirements: keine; empfohlen werden linguistische Grundkenntnisse	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.EP.022: Linguistik (C) - Basismodul**	12 C 4 WLH
Learning outcome, core skills: • Deepening and broadening of BA-level linguistic knowledge and competence with regard to speech systems (phonology, morphology, syntax, semantics) and linguistic usage (pragmatics, socio-linguistics, psycho-linguistics) • Ability to apply linguistic methods and hypotheses in key fields of research in modern linguistics • Knowledge of and ability to critically analyze strategies of argumentation as well as make structured description of linguistic content.	**Workload:** Attendance time: 56 h Self-study time: 304 h
Course: 1) Survey of English Linguistics (4SWS) or 2) Independent Study on the Introduction to Formal Syntax and Semantics (2SWS) *Contents*: The class can take the form of either a lecture series (4 SWS, offered every WS) or a seminar (2 SWS, offered every SS). The seminar includes a 2hr/week self-study which much be completed. The scientific research of the structure of language is exemplarily presented and applied at the level of phonology, morphology, syntax, and semantics. In order to adequately comprehend the use of language, the interdisciplinary application of socio-, pragma- and psycholinguistic will be introduced and their specific methods presented. The focus will be the methods of syntactic and semantic analysis and their application to the central constructions of English. Independent studies comprise 180 hours of the total self-study and will be accompanied by regular contact with the instructor during the semester. Progress will be assessed through a portfolio.	4 WLH
Examination: Learning journal (max. 20 pages) **Examination prerequisites:** Regular active participation with no more than two excused absences.	12 C
Examination requirements: The student must demonstrate knowledge of the structural units and structural relationships of English, mastery of linguistic methods of analysis, and be able to give a structured representation of linguistics. The student must demonstrate the ability to make use of methods and functions of linguistic research in a specific area under supervision, and that they can independently evaluate and assess results of analysis.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of the terms and modern linguistic concepts.
Language:	**Person responsible for module:**

English	Prof. Dr. Hedzer Hugo Zeijlstra
Course frequency: 1) jedes WiSe; 2) jedes SoSe	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 80	

Additional notes and regulations:
This module is designed for students with little knowledge of the areas of theoretical syntax or semantics who wish to specialize in English linguistics.

Georg-August-Universität Göttingen **Module M.EP.02b: Medieval English Studies**	6 C 4 WLH

Learning outcome, core skills: After successful participation in the course, students should be able to • demonstrate text competence with regard to the chief works of medieval English literature • understand important literary theoretical questions and apply them with regard to medieval English texts • demonstrate a good knowledge of the materiality of medieval English manuscript transmission • utilize a good competence in English on an advanced academic level • recognize aspects of the alterity of medieval texts as a didactic stimulus for an encounter with the Middle Ages as an alien culture	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Lecture series: Medieval Studies (Lecture) *Contents*: The lectures offer - in alternating semesters - a survey of the medieval literature of England, the historical development of English and selected subjects in the area of paleography, important language landmarks, and the cultural history of the English Middle Ages.	2 WLH
2. Course: Medieval Studies (Seminar)	2 WLH
Examination: Written Exam (90 minutes) or Term Paper (max. 5000 words) **Examination prerequisites:** Regular active participation with no more than two excused absences. **Examination requirements:** Successful candidates will demonstrate a good knowledge of the linguistic and literary/poetical aspects of important works of the English Middle Ages, as well as a good knowledge of their historical and material contexts, on the basis of which they will be able to develop a creative approach to an understanding of these texts.	

Admission requirements: B.EP.204	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Rudolf
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.EP.03-N: English Language Skills**	6 C 2 WLH
Learning outcome, core skills: After successful completion of the course, the student should be able to: • demonstrate optimized, practical linguistic knowledge and techniques learned in the selected area of study (e.g., writing essays, aural/reading comprehension, translation, public speaking) • use and apply this knowledge, above all in the context of their field of study (e.g., writing papers and giving presentations)	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Practical Course: Post-CLC-Course (Advanced Essay Training or Aural/ Reading comprehension or Advanced Translation or Vocabulary Training or Discussion and Essay Writing)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Course: Practical Course: Post-CLC-Course (Advanced Presentation and Discussion) The student can elect this course as an alternative to the above course.	2 WLH
Examination: Oral exam with accompanying discussion (30 min.) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Course: Independent Study according to the Post-CLC-Course *Contents*: The student should be able to apply a broadened and optimized use of acquired knowledge and techniques in a selected field of linguistic study, so that they can complete situational and complex tasks without difficulty. They should be able to utilize their active and passive linguistic competence in a scholarly way. Details of the Independent Study might vary accordingly. In the course "Advanced Aural Comprehension" the student should deepen their aural comprehension competence in English. This might include summarizing audio recordings and/or producing annotated bibliographies outside of the course's reading list. The student should produce a term paper (max. 2200 words). In the Course "Vocabulary Training" the student should expand their English vocabulary. Possible tasks: a student might summarize a text (e.g., a newspaper article) containing words not introduced during the course, or produce an annotated bibliography of books not on the course's reading list, but for which there is no time to discuss in the course; explain an essay or a short story in English regarding an aspect of the course (e.g., Idioms in Use). At the conclusion of the course the student should produce a term paper (max. 2200 words). The Independent Study comprises 75 hours of the entire self-study.	

Examination requirements: The student should have demonstrated an ability to apply a deep and broad knowledge of English, through an application of the content and techniques they have learned in the particular area of study, to complete complex tasks in thematically and situationally-appropriate ways, and to use their active and passive linguistic knowledge in field-oriented tasks.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.031-N: Comprehensive English Language Skills	6 C 4 WLH
Learning outcome, core skills: After successful completion of the course, the student should be able to: • demonstrate optimized, practical linguistic knowledge and techniques learned in the selected area of study (e.g., writing essays, aural/reading comprehension, translation, public speaking) • use and apply this knowledge, above all in the context of their field of study (e.g., writing papers and giving presentations)	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Practical Course: Post-CLC-Course (Advanced Essay Training or Aural/ Reading comprehension or Advanced Translation or Vocabulary Training or Discussion and Essay Writing) *Contents*: depending on the results of the diagnostic test: on e.g. English grammar; reading comprehension; listening comprehension; text production; academic writing; pronunciation One of these courses may be taken as an online course or online training if the supervisor agrees.	4 WLH
Examination: Learning journal (max. 3500 words) **Examination prerequisites:** Regular active participation with no more than two excused absences. **Examination requirements:** Students show that they have considerably improved their skills in those areas where the diagnostic test results pointed to a substandard level of competence; this includes that they can cope with tasks pertaining to those areas well and within a specific time period.	6 C
Examination requirements: The student should have demonstrated an ability to apply a deep and broad knowledge of English, through an application of the content and techniques they have learned in the particular area of study, to complete complex tasks in thematically and situationally-appropriate ways, and to use their active and passive linguistic knowledge in field-oriented tasks.	

Admission requirements:	**Recommended previous knowledge:**
• Participation in a diagnostic test offered by the Department of English that covers those areas relevant for a MA degree programme (grammar, listening comprehension, reading comprehension, text production) • Result of this diagnostic test point to a substandard competence in some of those areas	none

• Participation in an appraisal meeting in which students are advised about strategies and measures to be taken to support students in these areas	
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra Dr. Frauke Reitemeier
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: not limited	

Additional notes and regulations:
This module is aimed at students whose diagnostic test results point to a substandard competence in some key areas of using English (e.g. grammar, listening comprehension, reading comprehension, text production) so that measures should be taken to improve their skills.

Georg-August-Universität Göttingen **Module M.EP.032-N: Advanced English Language Skills**	6 C 2 WLH

Learning outcome, core skills: After successful completion of the course, the student should be able to: • demonstrate optimized, practical linguistic knowledge and techniques learned in the selected area of study (e.g., writing essays, aural/reading comprehension, translation, public speaking) • use and apply this knowledge, above all in the context of their field of study (e.g., writing papers and giving presentations)	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Practical Course: Post-CLC-Course (Advanced Essay Training or Aural/ Reading comprehension or Advanced Translation or Vocabulary Training or Discussion and Essay Writing)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	3 C

Course: Practical Course: Post-CLC-Course (Advanced Presentation and Discussion) The student can elect this course as an alternative to the above course.	2 WLH
Examination: Oral exam with accompanying discussion (30 min.) **Examination prerequisites:** Regular active participation with no more than two excused absences.	3 C

Course: Independent Study according to the Post-CLC-Course *Contents*: The student should be able to apply a broadened and optimized use of acquired knowledge and techniques in a selected field of linguistic study, so that they can complete situational and complex tasks without difficulty. They should be able to utilize their active and passive linguistic competence in a scholarly way. Details of the Independent Study might vary accordingly. In the course "Advanced Aural Comprehension" the student should deepen their aural comprehension competence in English. This might include summarizing audio recordings and/or producing annotated bibliographies outside of the course's reading list. The student should produce a term paper (max. 2200 words). In the Course "Vocabulary Training" the student should expand their English vocabulary. Possible tasks: a student might summarize a text (e.g., a newspaper article) containing words not introduced during the course, or produce an annotated bibliography of books not on the course's reading list, but for which there is no time to discuss in the course; explain an essay or a short story in English regarding an aspect of the course (e.g., Idioms in Use). At the conclusion of the course the student should produce a term paper (max. 2200 words). The Independent Study comprises 75 hours of the entire self-study.	

Examination requirements: The student should have demonstrated an ability to apply a deep and broad knowledge of English, through an application of the content and techniques they have learned in the particular area of study, to complete complex tasks in thematically and situationally-appropriate ways, and to use their active and passive linguistic knowledge in field-oriented tasks.	

Admission requirements: • Participation in a diagnostic test offered by the Department of English that covers those areas relevant for a MA degree programme (grammar, listening comprehension, reading comprehension, text production) • Result of this diagnostic test point to a standard or above-standard competence in those areas • Participation in an appraisal meeting in which students are advised about strategies and measures to be taken to support students in further improving their language skills	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra Dr. Frauke Reitemeier
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.04a: Advanced Anglophone Literature and Culture	6 C 4 WLH
Learning outcome, core skills: • A deeper and broader understanding of literary and cultural studies • The competence to synthesize textual analysis and the systematic parameters of the field by means of a sample research problem.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Lecture series on English literature and cultural history**	2 WLH
2. Seminar on English literature and cultural studies	2 WLH
Examination: Term Paper (max. 9000 words) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Examination requirements: • Demonstration of knowledge of textual analysis and systematic theoretical competence with regard to a sample research problem • Research competence and a critical approach to secondary sources	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.04b: Advanced North American Literature and Culture	6 C 2 WLH

Learning outcome, core skills:	**Workload:**
• Research-oriented subject-specific deepening of "North American Studies". • Understanding of the problems of theoretical textual analysis (mainly literary texts) through the use of sample research problems • The competence to self-reflect with regard to subject-specific and interdisciplinary methodologies • The competence to synergistically use literary and cultural studies methodologies	Attendance time: 28 h Self-study time: 152 h

Courses:	
1. American Studies Seminar In this course students will acquire a foundational knowledge of the questions and positions of literary and cultural theory. They will develop an informed competence to analyze and critique literary and non-literary texts. Moreover they will investigate and compare different theories critically and develop their own research theses and discuss them at a scholarly level.	2 WLH
2. Independent Study: "Literary Theory" For an Independent Study (60 hours of the total self-study), the student will work on a subject in the field of literary theory agreed upon with the instructor in advance. The goal is a thematically-focused, theoretically and methodologically supported self-study supported by relevant literary and cultural-theoretical primary and secondary texts in field-specific research publications and databanks. The student should develop the ability to reflect upon their approach to the subject, to have a scholarly dialog with the instructor regarding their term paper with regard to establishing and placing the paper in the context of the field. Through the Independent Study, the student should deepen their understanding of methodology and theory. The student should gain an understanding of research-oriented work and an informed analysis and critique of literary and non-literary texts. Progress will be assessed through a minimum of three meetings with the instructor.	
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused absences; for an independent study three meetings with the instructor.	

Examination requirements:	
Literary research; critical approach to secondary literature; formulation of a research thesis; independent scholarly research.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency:	**Duration:**

each semester	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 60	

Georg-August-Universität Göttingen Module M.EP.05a: Advanced English Linguistics	6 C 2 WLH
Learning outcome, core skills: • The competence to verify linguistic theories and to apply argumentation strategies to a specific research project • Knowledge of alternative approaches to the core material as well as the ability to critically assess and grasp new theoretical developments	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Linguistic seminar**	2 WLH
2. Independent Study *Contents*: The goals are: a) competency in assessing scholarly research in the field, b) competence in a meaningful and correct application of linguistic theories regarding linguistic phenomena in the area of study, c) advanced knowledge of the subject, as necessary for meaningful class participation, and as is necessary to acquire if not present prior to the beginning of the course. Independent studies comprise 60 hours of the total self-study and will generally require a minimum of three meetings with the instructor during the semester. Progress will be assessed in interviews and/or through written assignments, subject to prior agreement.	
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused absences; for an independent study three meetings with the instructor.	
Examination requirements: Demonstration of the ability to research and absorb relevant research on a linguistics-relevant subject, to extract relevant research questions, to analyze differentiated linguistic objects, and to select and evaluate an appropriate theory.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.EP.05b: Encountering the Medieval Text**	6 C 2 WLH
Learning outcome, core skills: • An understanding of selected texts of medieval English literature in their linguistic and literary contexts through intensive textual study • To approach texts with a meaningful understanding of historical context, textuality and provenance • The application of selected aspects of medieval and contemporary literary theories to specific texts • The application of editing techniques with regard to modern media	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Course: Medieval Studies** (Seminar)	2 WLH
2. Independent Study *Contents*: Independent research of a topic; application of research methods, e.g., catalogues, databases, or text corpus; a minimum of two tutorials per semester offering instruction, feedback, and supervision; 75 hours of the entire self-study.	
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused absences. **Examination requirements:** Familiarity with important currents of literary and cultural theory; application of theoretical knowledge on texts with a view of provenance; a confident encounter with relevant research publications, databases, and text corpora.	

Admission requirements: M.EP.02b	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Rudolf
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.EP.06a: Degree Course: Anglophone Literature and Culture**	6 C 2 WLH
Learning outcome, core skills: • Research-oriented, field-specific deepening of the subject; understanding of the problems of theoretical textual analysis (above all with literary texts) with regard to a specific sample problem • The competence of field-specific and interdisciplinary self-reflection • The competence of a synthetic use of literary and cultural studies methodology	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Colloquium	2 WLH
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Examination requirements: • Demonstration of a fundamental knowledge of the field as well as competence of theoretical and textual analysis • An informed demonstration of an understanding of different theoretical and research approaches • A synergetic use of literary and cultural studies methodologies	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Additional notes and regulations:
This module is aimed at students writing their MA thesis on a topic from Anglophone Literature and Culture.

Georg-August-Universität Göttingen **Module M.EP.06b: Degree Course: North American Literature and Culture**	6 C 4 WLH
Learning outcome, core skills: • Deepening of the knowledge of cultural- and literary- historical analysis of American studies through a research-oriented focus on a textual analysis of a sample research question (with the possibility of developing a master's thesis) • Application of said methodology • Review of the unity and exceptionality of the subject North American Studies and field-specific knowledge of the same (in colloquium)	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Seminar: American Studies	2 WLH
2. Colloquium: American Studies	2 WLH
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Examination requirements: A method-based presentation of research positions; review of the unity and exceptionality of the subject North American Studies and field-specific knowledge of the same.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 80	

Georg-August-Universität Göttingen Module M.EP.07a: Degree Course: English Linguistics	6 C 2 WLH
Learning outcome, core skills: • Deepening and specialization in an area of study • Research-oriented focus on a linguistic problem (with the possibility of developing a master's thesis) • Competence in linguistic discourse • To enable the student (with the colloquium) toward an interdisciplinary embedding and reflection upon linguistic problems and subject area within the context of specific research paradigms as well as the explication of field-specific-scholarly relevance	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Colloquium: Linguistics	2 WLH
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Regular active participation with no more than two excused absences.	
Examination requirements: Demonstration of interdisciplinary embedding and reflection upon linguistic problems and subject area within the context of specific research paradigms as well as the explication of field-specific-scholarly relevance.	

Admission requirements: M.EP.05a	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.07b: Degree Course: Medieval English Studies	6 C 1 WLH
Learning outcome, core skills: After successful completion, students will be able to: • Present their own research using appropriate forms of presentation • Demonstrate test-oriented, comprehensive knowledge of English Medieval Studies • Lead academic dialogue with graduates and formulate research questions independently • Undertake in-depth analysis of the latest literature	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Independent Study *Contents*: Independent work on a research topic; Practice of research techniques, for example, with catalogs, databases or corpora; at least two tutorials per semester in which instruction, feedback and monitoring of results take place; Scope of the Independent Study: 75 hours of total self-study	
Course: Colloquium *Contents*: • Exposure to current research topics in dialogue with graduates • Presentation and evaluation of independent research work • Exam Preparation / repeat	1 WLH
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Regular, active participation with no more than two excused missed sessions; 1 research presentation **Examination requirements:** Sound knowledge in several areas of English Medieval Studies; critical analysis of current issues in teaching and research on the English Middle Ages.	

Admission requirements: für Studierende des MA Studiengangs Englische Philologie: M.EP.05b; für Studierende des MA Studiengangs Mittelalter- und Renaissancestudien: M.EP.05b oder M.EP.13	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Rudolf
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.EP.08a: American Culture and Institutions / British Culture and Institutions (for MA Students)**	6 C 2 WLH
Learning outcome, core skills: • Training of advanced cultural and intercultural skills • Comparison of various Anglophone / North American cultural areas, as well as cultural practices amongst each other • Autonomous development of in-depth knowledge in the field of regional history and specific culture-bound practices	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Advanced American Area Studies / American Culture and Institutions or Advanced British Area Studies /British Culture and Institutions**	2 WLH
2. Independent Study *Contents*: As part of the Independent Study which comprises 75 hours of the total self-study students deepen and broaden their skills in cultural studies by reflecting on some of the course content whilst carrying out various tasks. This is done, for example, by students designing a game that helps learners to better understand aspects of British culture and to have fun at the same time; by creating an annotated bibliography of books, which, although on the course book list, cannot be dealt with in depth due to lack of time during the course; by writing an essay or a 'survival guide', a poem, etc. on an aspect of the course, in which the main focus should be placed on how students would react to selected situations in Great Britain. At the end of the course, students submit appropriate work. There will be opportunity for consultation and supervision in the seminar.	
Examination: Written Exam (90 Min.) or Essay (about 3000 words) or Presentation with the additional Discussion (about 30 Min.) [The mode of the examination will be set at the beginning of the course in UniVZ] **Examination prerequisites:** Regular active participation with no more than two excused classes missed.	
Examination requirements: Sound knowledge of the culture, history and specific culture-bound practices of the country and the ability to compare different Anglophone / North American culture areas.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.EP.09a: Research Course: Anglophone Literature and Culture**	12 C 2 WLH
Learning outcome, core skills: • Deepening and consolidation of the knowledge of literary studies attained in the Bachelor's degree program in the sub-discipline of Anglophone Literature and Cultural Studies. • Ability to create a synopsis of the text-analytical, practical and systematic-theoretical parameters of the discipline by using the theory-based investigation of a research problem selected by the students themselves. • Deepening of academic autonomy through guided research, bibliography and critical analysis of research approaches. • Discussion and analysis of literary / cultural theory approaches to ascertain their applicability to a specific topic. • Developing autonomy in terms of research and critical assessment of secondary literature through feedback sessions and regular discussions to present the chosen research area.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Courses: **1. Colloquium** Im Kolloquium erhalten Studierende in erster Linie Einblick in die Arbeitsweise anderer Absolventen. Sie vertiefen ihre Kenntnis der Anwendbarkeit von Theorien und Methodologien durch Beobachtung und Reflexion und schulen ihre analytischen Fähigkeiten in der kritischen Diskussion des Forschungsstands anderer Projekte. **2. Independent Study** *Contents*: For the Independent Study part comprising 332 self-study hours, a thematically focused research topic will be agreed with the teacher of the accompanying class which will be developed in theoretical and methods-based self-study. In addition, relevant research methods are practiced, primary and secondary texts compiled and research theses drawn up which will be discussed with the teacher in academic dialogue. Students develop the ability to work independently and in a scientifically research-oriented manner and thereby reflect critically on their own approaches. In the Independent Study parts, students develop their methodological skills and their appreciation of theory. Instruction, feedback and review of progress take place in at least three meetings distributed over the lecture period.	 2 WLH
Examination: Learning journal (max. 6000 words) **Examination prerequisites:** Regular active participation; Short presentation of a research project. **Examination requirements:** • Methodologically-sound and critical account of theories and research positions	

• Reliable research skills and critical approach to the research literature. The work put into the portfolio may include, but is not limited to, a presentation of a research project and / or a critical outline of the literature on a research project.	

Admission requirements: M.EP.04a proof of the obligatory counselling according to § 6 (4) of the regulations	**Recommended previous knowledge:** M.EP.01a
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Additional notes and regulations: This module is exclusively designed to help students conceptualize and prepare a research project that leads into a draft master's thesis.

Georg-August-Universität Göttingen **Module M.EP.09b: Research Course: North American Literature and Culture**	6 C 2 WLH
Learning outcome, core skills: • Deepening and consolidation of the literary knowledge obtained during the Bachelor's program in the area of North American Studies • Ability to create a synopsis of the text-analytical, practical and systematic-theoretical parameters of the discipline by using a theory-based investigation of a research problem selected by the students themselves. • Deepening of academic autonomy through guided research, bibliography and critical analysis of research approaches. Main contents: • Advanced text-analytical skills • Intensive critical examination of a range of literary / cultural, or theoretical positions • Self-critical observation of one’s own approaches, techniques and analysis results • Enhancement of independence in terms of research and critical assessment of the secondary literature through feedback sessions and in regular meetings in oder to present the chosen research area	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. 1. Research and research-focused course for 2 hours per week on North American culture and literature**	2 WLH
2. Independent Study *Contents*: For the Independent Study component, which comprises 75 hours of the total self-study part, a topic in the field of American Studies previously agreed with a teacher will be worked on independently. The learning objective is a thematically focused, theory and methods-based self-study for which relevant primary and secondary texts are researched in technically relevant scientific databases and publications, and research theses designed. Students learn to develop the ability to critically reflect on their own approaches, to substantiate them in academic dialogue with the teacher on the basis of thesis papers and to define their place in a professional context. In the Independent Study parts of the American Studies modules, students extend their methodological skills and appreciation of theory. They build up their ability to work independently and in a scientifically research-oriented fashion. Instruction, feedback and review of progress take place in at least three meetings distributed over the lecture period.	
Examination: Term paper or research report (max. 7500 words) **Examination prerequisites:** Regular active participation; Short presentation of a research project. **Examination requirements:** Demonstration of ability to comprehensively research the literature; critical approach to secondary literature; ability to formulate own research theses; ability to work independently and scientifically.	6 C

Admission requirements: M.EP.01b The proof of the obligatory advisement according to § 6 (4) of the the regulations.	**Recommended previous knowledge:** M.EP.04b
Language: English	**Person responsible for module:** Prof. Dr. Bärbel Tischleder
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.EP.09c: Research Course: English Linguistics**	12 C 4 WLH
Learning outcome, core skills: • Deepening and consolidation of linguistic knowledge attained during the Bachelor's degree in the area of Modern English. • Ability to create a synopsis of the text-analytical, practical and systematic-theoretical parameters of the discipline by using a theory-based investigation of a research problem selected by the students themselves. • Deepening of academic autonomy through guided research, bibliography and critical analysis of research approaches. • Competence in carrying out an intense critical analysis of various linguistic positions.	**Workload:** Attendance time: 56 h Self-study time: 304 h
Course: Research oriented Cours	2 WLH
Course: Linguistic Colloquium *Contents*: The qualification aim of this part of the module is the acquisition of skills in extrapolation of subject-specific and theoretical positions from the research literature, as well as presentations on current issues and research topics in linguistics. These should be commented and reflected on, and classified in a research outline.	2 WLH
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation in both classes with no more than two excused classes missed; ungraded research report (max. 5000 words)	
Examination requirements: Students must demonstrate that they can deal with methods and modes of practice in linguistic research in a generic area under guidance that they can independently evaluate analysis results and evaluate these critically. They must demonstrate that they can research the relevant literature independently and can critically assess the secondary literature. They must demonstrate that they can present their chosen field of research.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students:	

20	

Georg-August-Universität Göttingen **Module M.EP.09e: Research Course: English Linguistics - Peer-to-Peer Assistantship**	12 C 2 WLH

Learning outcome, core skills: • Deepening and consolidation of linguistic knowledge attained during the Bachelor's degree in the area of Modern English. • Ability to create a synopsis of the text-analytical, practical and systematic-theoretical parameters of the discipline by using a theory-based investigation of a research problem selected by the students themselves. • Deepening of academic autonomy through guided research, bibliography and critical analysis of research approaches. • Competence in carrying out an intense critical analysis of various linguistic positions.	**Workload:** Attendance time: 28 h Self-study time: 332 h

Course: Linguistic Colloquium *Contents*: The qualification aim of this part of the module is the acquisition of skills in extrapolation of subject-specific and theoretical positions from the research literature, as well as presentations on current issues and research topics in linguistics. These should be commented and reflected on, and classified in a research outline.	2 WLH
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation in both classes with no more than two excused classes missed; ungraded research report (max. 5000 words) **Examination requirements:** Regular active participation in both classes with no more than two excused classes missed; ungraded research report (max. 5000 words)	6 C

Course: Research-oriented Course *Contents*: Students perform a support for peer students with a different linguistic background. They are expected to tutor one or two students to enable them to attend an advanced linguistic course esp. with reference to theoretical and/or formal concepts required for successful completion. The peer company is established and supervised by the instructor. Peer meetings should be on a weekly basis to follow the course's progression.	2 WLH
Examination: Learning journal (max. 3500 words), not graded	6 C

Examination requirements: Students must demonstrate that they can deal with methods and modes of practice in linguistic research in a generic area under guidance that they can independently evaluate analysis results and evaluate these critically. They must demonstrate that they can research the relevant literature independently and can critically assess the secondary literature. They must demonstrate that they can present their chosen field of research.	

Admission requirements: by individual call / address by instructor	**Recommended previous knowledge:** advanced linguistic course and term paper
Language: English	**Person responsible for module:** Prof. Dr. Hedzer Hugo Zeijlstra
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.EP.10a: Historical Aspects of Anglophone Literature and Culture**	6 C 4 WLH
Learning outcome, core skills: • Deepening of general knowledge of Anglophone literary history from the Renaissance to the present day (main focus: general overview and critical reflection thereupon) • Subject / structure-based independent analytical and comparative treatment of core texts of Anglophone literary history	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Lecture on Anglophone literature** (Lecture)	2 WLH
2. Tutorial or Independent Study *Contents*: For the Independent Study part, which comprises 60 hours of the total self-study component, a thematically focused research subject agreed with the teacher of the accompanying course will be worked on in theoretical and methods-based self-study. In addition, relevant research methods are practiced; primary and secondary texts studied and research theses drawn up in academic dialogue with the teacher. Students develop the ability to work independently in a scientifically research-oriented manner, and thereby to reflect on their own approaches critically. In the Independent Study parts, students develop their methodological skills and their appreciation of theory. Instruction, feedback and review of progress take place in at least three meetings distributed over the lecture period.	2 WLH
Examination: 4 Reading Logs to reflect on primary and secondary literature (up to a maximum of 9000 words) **Examination prerequisites:** Regular active participation with no more than two excused classes missed; three meetings with a teacher are a prerequisite for the Independent Study part.	6 C
Examination requirements: • Proof of sound general knowledge of literature and cultural history • Demonstration of the ability to critically reflect on methodology	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen Module M.EP.10b: Anglophone Literature in Focus	6 C 2 WLH

Learning outcome, core skills: • Autonomous analytical and comparative study of core texts in Anglophone literary history and its academic representation, treatment and reception • Deepening of analytical and presentation skills in the field of Anglophone literary history from the Renaissance to the present day (main focus: general knowledge / cross-linking of texts)	**Workload:** Attendance time: 28 h Self-study time: 152 h

Courses:	
1. Seminar on History of Anglophone Literature (Seminar)	2 WLH
2. Independent Study *Contents*: For the Independent Study part, which comprises 75 hours of the total self-study component, a thematically focused research topic will be agreed with the teacher of the accompanying class which will be developed in theoretical and methods-based self-study. In addition, relevant research methods are practiced, primary and secondary texts compiled and research theses drawn up to be discussed with the teacher in academic dialogue. Students develop the ability to work independently and in a scientifically research-oriented manner and thereby reflect critically on their own approaches. In the Independent Study parts, students develop their methodological skills and their appreciation of theory. Instruction, feedback and review of progress take place in at least three meetings distributed over the lecture period.	
Examination: Oral Presentation (approx. 30 minutes) **Examination prerequisites:** Regular active participation with no more than two excused classes missed; three meetings with a teacher are a prerequisite for the Independent Study part. **Examination requirements:** Main focus: representation of and reflection on general overview (30 min.) followed by a discussion; in addition a written report (about 5000 words)	6 C

Examination requirements: • Proof of general knowledge overview of literary history and historical reception, as well as of theory-led, text-analytical competencies • Methodologically sound presentation of theories and research positions • Ability to critically compare core texts of different eras	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.EP.10c: Anglophone Literature(s) - Developments and Contrasts**	12 C 4 WLH

Learning outcome, core skills: • Deepening of general knowledge of Anglophone literary history from the Renaissance to the present day (main focus: general overview and critical reflection thereupon) • Autonomous critical and comparative analysis of core texts of various eras taking into account the current literature and historical research-related reception	**Workload:** Attendance time: 56 h Self-study time: 304 h

Courses:	
1. Class (e.g. lecture) on Anglophone literary history	2 WLH
2. Class (e.g. lecture, reading seminar)	2 WLH
3. Independent Study *Contents*: In the Independent Study part (135 hours of the total self-study component), the themes and texts dealt with in class will be deepened in theory and methods-based self-study and literary and cultural critical skills extended. In addition, relevant research methods are practiced; primary and secondary texts studied and research theses drawn up in academic dialogue with the teacher. Students develop the ability to work independently in a scientifically research-oriented manner, and thereby to reflect on their own approaches critically. In the Independent Study parts, students develop their methodological skills and their appreciation of theory.	
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** Regular active participation with no more than two excused meetings missed.	12 C

Examination requirements: In the exam, students furnish proof of an overall appreciation of literary historical, cultural historical and reception history either on the basis of a thesis paper on both classes, or on the basis of a reading list from both classes, as well as proof of theory-driven text analytical skills. They show that they can present methodologically sound theories and research positions and that they can recognize, outline and critically reflect on lines of development within individual eras.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.10d: Topics in Anglophone Literature	6 C 2 WLH
Learning outcome, core skills: • Autonomous analytical and comparative study of core texts in Anglophone literary history and its scientific representation, treatment and reception • Deepening of research-oriented analysis expertise in a group themes related to Anglophone literary history	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Course on History of Anglophone Literature In addition to concentrating on the course contents the self-study part of the module also includes further in-depth reading and the preparation of contexts and further secondary literature independently, e.g. based on a detailed reading list.	2 WLH
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused classes missed; three meetings with a teacher are a prerequisite for the Independent Study part.	6 C
Examination requirements: • Proof of sound scientific knowledge of literature • Proof of sound text-analytical skills • Demonstration of ability to reflect on research positions • Sound research skills and critical approach to the research literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.EP.10e: English Literature(s) in the Global Context**	6 C 2 WLH

Learning outcome, core skills: • Deepening of research-oriented analysis expertise in a group of themes in the non-core subjects of British / English Literatures (e.g. Caribbean, Canadian, Indian, South African literature) • Cross-linking of knowledge between (canonical) British / English and English-language literature outside of the British Isles • Autonomous study of analytical and comparative core texts in Anglophone literary history and their scientific representation, treatment and reception, also taking intercultural contexts into account	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Course on History of Anglophone Literature In addition to concentrating on the course contents the self-study part of the module also includes further in-depth reading and the preparation of contexts and further secondary literature independently, e.g. based on a detailed reading list.	2 WLH

Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused meetings missed; For the Independent Study part, participation in three meetings with the teacher is required.	6 C

Examination requirements: • Proof of sound knowledge of the literature and cultural context of the selected Anglophone branch • Sound research skills and critical approach to the research literature • Demonstration of comparative text-analysis skills in dealing with canonical texts in British literature	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.EP.10f: Anglophone Literature and Culture: A Critical Survey	12 C

Learning outcome, core skills:	**Workload:**
The aim of this module is to impart to students in independent study an in-depth knowledge of a literary / cultural-historical era. After successful completion, students prepare, present and successfully defend a subject for a short academic presentation in a professional academic discussion. After successful participation: • Students will know the core texts and core events of the chosen period and be able to outline them in their development. • Students will be able to show differences and parallels in structure, functionality and subject matter using core texts of the chosen period selected by the students themselves, and be able to critically assess them. • Students will have an overview of non-literary forms of publication in this period (e.g., periodical literature, broadsides, cartoons, ...) and be able to assess their relevance to the literary / cultural-historical context. • Students will have an overview of other cultural forms of representation (art, music, architecture) of the chosen period and be able to name major works and producers (artists, musicians). • Students will have an overview of differing representations of this period in literary and cultural histories and be able to critically evaluate them. • Students will be familiar with and have a general overview of the current state of literary-critical research of the chosen period. • Students will be able to outline a general overview of the current state of literary-critical research on a core study area chosen by the students themselves and evaluate the approaches critically. • Students will be able to approach various literary / cultural theory approaches to the texts or key events of the chosen period, name their strengths and weaknesses, and critically evaluate them in the analysis results. • Students will know the central databases (primary / secondary texts) for the chosen period, assess their utility, and be able to use them systematically for research.	Attendance time: 0 h Self-study time: 360 h

Course: Online unit	
Contents: With the online unit, coupled with about 360 hours of self-study time, students gradually and independently deepen their knowledge of a literary /cultural-theoretical period. The module expands the knowledge of students in the following areas: • Overall knowledge of text, both literary and non-literary • Text analysis and text comparison, both literary and non-literary • Literary / cultural-historical overview • State of research / secondary literature	

• Literary / cultural-theoretical approaches • Research tools • (self-management, time management) *Course frequency:* jedes Semester	

Examination: Lecture (approx. 45 minutes) **Examination prerequisites:** Successful completion of an online learning module with separate work on individual chapters **Examination requirements:** Short presentation (15 mins.) on a core area from the chosen period (e.g. text comparison, research question, presentation of overview) with subsequent discussion. Students demonstrate that they can: • summarize an independently chosen core area in a short lecture which includes the key aspects relevant for a scientific presentation (embedding, methodology, research situation, argumentation, thesis) • present their theses in a sound and coherent way • defend and argue these in a discussion on the subject.	12 C

Examination requirements: • Proof of general knowledge of literary and cultural-history • Proof of capacity for critical reflection on methodology	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: winter or summer semester, on demand	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Additional notes and regulations: The module cannot be taken simultaneously with module M.EP.01a.

Georg-August-Universität Göttingen Module M.EP.10g: Non-European Backgrounds	6 C 2 WLH
Learning outcome, core skills: Students have a basic knowledge of the historical, political and social background of a region in which Anglophone literature is produced and received (e.g., India, South Africa, Australia, New Zealand). They know key aspects of the development of economic and social structures. They have enough basic theoretical knowledge to grasp and describe the developments in each case. They know key events and can explain their significance in wider contexts. They know sources for research on additional literature, and possess the appropriate skills to deal with them.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Course** **2. Independent Study or practice** *Contents*: For the Independent Study part, which comprises 75 hours of the total self-study component, a thematically focused research topic will be agreed with the teacher of the accompanying class and be developed in theoretical and methods-based self-study. In addition, relevant research methods are practiced, primary and secondary texts compiled and research theses drawn up to be discussed with the teacher in academic dialogue. Students develop the ability to work independently and in a scientifically research-oriented manner and thereby reflect critically on their own approaches. In the Independent Study parts, students develop their methodological skills and their appreciation of theory. Instruction, feedback and review of progress take place in at least three meetings distributed over the lecture period.	 2 WLH
Examination: Written examination (90 min.) or term paper (max. 5000 words) **Examination requirements:** Basic knowledge of the specific historical, political and societal idiosyncrasies of a region producing Anglophone literature (depending on the chosen course); general knowledge of events and developments that particularly characterize the respective society / history of this region; ability to contextualize this knowledge.	6 C

Admission requirements: none	**Recommended previous knowledge:** Knowledge of the anglophone authors as well of the English texts from the non-European cultural areas is recommended.
Language: English, German	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students:	

not limited	

Additional notes and regulations: This module is intended to provide students who have a focus of interest in the field of post-colonial literature with background knowledge on the respective region. If credits are required for external work (e.g. courses at other universities, or summer school courses), graded certificates must be provided as evidence.

Georg-August-Universität Göttingen **Module M.EP.11: The Medieval Text in Manuscript, Archive and Media**	12 C 4 WLH

Learning outcome, core skills: After successful completion, students will be able to: • Reliably read, transcribe and date medieval texts from England • Understand fundamental aspects of the study of books in the context of literary scientific theories; and apply edition methods • Describe original medieval manuscripts and understand methods of their cataloging, digitization, preservation and restoration • Practice medial presentation in print media, exhibitions and on the Internet • Become familiar with practical work contexts in archives on excursions	**Workload:** Attendance time: 56 h Self-study time: 304 h

Courses: **1. Independent Study** *Contents*: Independent work on a research topic; Practice of research techniques, e.g. with catalogs, databases or corpora; at least two tutorials per semester in which instruction, feedback and review progress take place; Scope of the Independent Study part: 280 hours of the total self-study period.	
2. Medieval studies (Seminar) *Contents*: Practicing making facsimiles; securing of precise textual knowledge *Course frequency:* jedes Wintersemester	2 WLH
Examination: Term Paper (max. 7500 words) **Examination prerequisites:** Regular active participation with no more than two excused meetings missed; Excursion preparation; adopting a manuscript; presentation **Examination requirements:** Term paper: familiarity with important literary and cultural theory trends; application of theoretical knowledge of the text including a look at its tradition history; working confidently with the relevant research literature, databases and scientific corpora; presentation: good use of relevant presentation techniques; ability to present complex information clearly	6 C

Course: Excursion *Contents*: • Excursion to a European manuscript library • Transcription exercises on real substantive text • Practice of identifying text and edition • Learning archiving techniques • Medial presentation in team	2 WLH
Examination: Excursion report (max. 2000 words)	6 C

Examination prerequisites: Regular active participation with no more than two excused meetings missed; presentation **Examination requirements:** Summary of excursion results using diverse media.	

Admission requirements: Für Studierende des MA Studiengangs Englische Philologie: M.EP.02b; Für Studierende des MA Studiengangs Mittelalter- und Renaissancestudien: M.EP.02b oder M.EP.02c.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Rudolf
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.EP.11a: Investigating Language: Tools and Skills**	12 C 4 WLH

Learning outcome, core skills: Acquisition of practical methods for investigating English and its historical stages, namely: • Competency to work with current and historical corpora • Skills for empirical data collection (children / adults) • Skills for discursive development of linguistic structures • Competences for the development of historical vocabularies and holdings • Skills for historical comparative linguistics	**Workload:** Attendance time: 56 h Self-study time: 304 h

Course: Various Tools and Skills for Investigating Language Two courses with a total of 2 hours per week must be taken from the following option subject areas: • Seminar / lecture in Statistics / Logic • Seminar in the field of Psycholinguistics / Corpus Linguistics • Seminar in the field of Paleography • Seminar in Latin Philology / Old German Studies / Old Romance Studies / Old Scandinavian Studies As an alternative to one of these classes, a tutorial may be taken as part of an introductory undergraduate seminar (*E-Proseminar*) in Medieval Studies or Linguistics.	4 WLH

Examination: Written examination (90 min.) or term paper (max. 7500 Wörter) **Examination prerequisites:** Regular active participation with no more than two excused meetings missed. **Examination requirements:** • Appropriate use of practical methods for determining and analyzing data relating to English • Review of the adequacy of an analytical method for a given issue • Presentation of methods and results	

Admission requirements: M.EP.020, M.EP.021, M.EP.02b	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Regine Eckardt Prof. Dr. Winfried Rudolf; Prof. Dr. Hedde Zeijlstra
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 25	

Additional notes and regulations:
In order to take the module, successful completion of either of the basic modules in Linguistics (M.EP.020 / M.EP.021), **or** the basic Medieval Studies module (M.EP.02b) is required.

Georg-August-Universität Göttingen Module M.EP.12a: Forms of Literary Reception	6 C 1 WLH
Learning outcome, core skills: Students extend their knowledge of the everyday use and reception of various text types from the Anglophone area in the print media and culture industry. They get to know the literary scene better by visiting events and thereby acquiring knowledge on the marketing of texts and authors. In addition, they acquire practical skills in a possible future professional area.	**Workload:** Attendance time: 14 h Self-study time: 166 h
Courses: **1. Attendance at two lectures on topics from the field of Anglophone Literature and Culture**	
2. Attendance at two readings on texts in the field of Anglophone Literature and Culture *Contents*: (E.g. Literary Autumn (*Literaturherbst*), Literary Center (*Literarisches Zentrum*), or outside of Göttingen)	
3. Visit to a theater or opera production on a text in Anglophone literature *Contents*: (E.g. Student Theater (*ThOP*), The German Theater (*DT*), The Young Theater (*JT*), or outside Göttingen; *Handel Festival*)	
4. Block seminar *Contents*: Brief presentation of subject matter, as well as critical reflection on the events attended; work on literary-sociological issues and theories.	1 WLH
Examination: Learning journal (max. 3000 words), not graded **Examination requirements:** • Reflection on the relationship between text / author and audience • Critical examination of the implementation of the relevant format **Content of Portfolio:** Reviews, summaries, self-written newspaper articles / blogs / podcasts on the attended events incl. background research and critical reflection; Short presentation (about 10 min.)	6 C

Admission requirements: none	Recommended previous knowledge: none
Language: English, German	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Georg-August-Universität Göttingen **Module M.EP.12b: Literary Events**	12 C 1 WLH
Learning outcome, core skills: Students enhance their knowledge about the approach to different English-speaking authors and text types in the context of literary events such as literary festivals or public readings. They reflect on how non-scientific recipients may utilize specific approaches to an author and his or her work. They acquire an overview of which texts and authors are absorbed by society. They improve their understanding of what target groups literary events aim at and learn to critically reflect on those events. In cooperation with the host institution, an internship may be utilized for a research-based master thesis.	**Workload:** Attendance time: 14 h Self-study time: 346 h
Courses: **1. Internship in a "Literary Business" (8-12 weeks, domestic or abroad)** (e.g with a publishing company that publishes English-speaking writers, for instance the *Literarisches Zentrum, Göttingen,* the *Literaturherbst*, the *Händel-Festspiele*, or with a "literary business" outside Göttingen.)	
2. Block Seminar *Contents*: Activity brief as well as a critical reflection on the marketing of English-speaking writers and their works in the literary scene; development of topics and theories concerning the sociology of literature.	1 WLH
Examination: Internship report (max. 4000 words), not graded **Examination requirements:** The internship report helps students to systematically document and reflect upon their internship experiences, and allows them to show that they know the specific challenges of the literature and culture industry, especially with regard to authors and publishing houses. Secondly, it allows them to show that they can critically reflect upon the realisation of the different formats, which they encounter. Furthermore, they show their abilities to adapt to the typical and untypical situations of the literature and culture industry and present their copying strategies, which they have developed for these situations. Focus of the internship report: · documentation of the internship: Students are not expected to give a detailed account of their internship but rather to describe the most important experiences and situations of their internship. Special attention is directed to the situations, which were most challenging during the internship. · reflections of the practical insights gained In the second part of the internship report students analyse and reflect upon their new findings and experiences. They critically think about and evaluate their findings with regard to their distinct role during their internship, as well as their studies, the literature and culture industry and their later potential field of work.	12 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: winter or summer semester, on demand	**Duration:** 1-2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Georg-August-Universität Göttingen Module M.EP.12c: Literary Museums and Literary Tourism	12 C 2 WLH
Learning outcome, core skills: Students enhance their knowledge about the theoretical and practical background of museums and become acquainted with the general, political, economic, and the internal as well as the external parameters of museums in general and literary museums in particular. They study the history and the practice of literary tourism. They acquire knowledge about the materiality of the exhibits and learn how to handle museum objects and concepts theoretically and practically. In cooperation with the host institution, an internship may be utilized for a research-based master thesis.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Courses: **1. Course/Lecture: Literature Industry** Can be attended before or after the internship.	 2 WLH
2. Practical Project Work Internship, domestic or abroad, in the field of literary museums or literary institutions (8-12 weeks)	
Examination: Internship report (max. 4000 words), not graded **Examination requirements:** • students must be capable of presenting the application for as well as the accomplishment of their internships, both orally and in writing • critical reflection about the approach to literature with regard to public reception	12 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Barbara Schaff
Course frequency: winter or summer semester, on demand	**Duration:** 1-2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3

Georg-August-Universität Göttingen **Module M.Forst.1511: Tropical forest ecology and silviculture**	6 C 4 WLH

Learning outcome, core skills: The module enables students to understand the most important ecological processes in zonal and azonal tropical forest formations, to analyse silvicultural systems critically considering their advantages and drawbacks, to design well adapted silvicultural systems, to analyse the ecological consequences of logging in tropical rain forests and finally, to plan and implement plantation programmes in different ecological tropical zones, and they are supposed to aquire a basis for silvicultural management of the different tropical forest formations.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Tropical forest ecology and silviculture (Lecture) *Contents*: This course focuses on the ecology of tropical rain forests, the threat to the forest and options for ecologically sound management. Lectures on forest ecology include the analysis of different tropical forest types such as lowland rain forest, montane forest, mangrove forest, the biodiversity of the forest, the role of fire, and the carbon balance of forests. More applied topics will analyse silvicultural systems such as polycyclic and monocyclic management systems.	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Based on the contents of the lecture students should be able to discuss crritically current and important questions in the field of tropical silviculture and forest ecology.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Dirk Hölscher
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1512: International Forest Policy and Economics**	6 C 4 WLH

Learning outcome, core skills: **Global environmental and forest policy:** The objective is that students get basic knowledge of both the key policies related to forests and the application of the policy analysis on such issues. Students acquire comprehension about global forest related policy processes and factual knowledge about forest actors affecting the policy on a global level. The seminar combines a lead-in to global policy theory and its translation in practical, empirical knowledge about actors and processes of high importance in forestry. The different instruments for international policy formulation and implementation are discussed using case studies. **International forest economics:** The lecture is split in two main areas: 'International Wood Markets' and 'International Environmental and Forest Conservation'. The first part deals with the international trade with wood and wood products. International markets and the consequences of protectionism are analysed. Furthermore, aspects of international wood marketing are shown. In the second part, international environmental problems are described and possibilities as well as constraints for international co-operation are discussed. Finally, relations between environmental conservation and economic development are analysed.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Global environmental and forest policy (Seminar)	2 WLH
Examination: Written examination (60 minutes) **Examination requirements:** • Knowledge about political theories on forest and environmental policies • Application of the policy analysis on forest and environmental policies	3 C

Course: International forest economics (Lecture)	2 WLH
Examination: Written examination (60 minutes) **Examination requirements:** • Knowlegde about international wood markets, international trade with wood, wood products, aspects of international wood marketing and the consequences of protectionism. • Knowlegde about international environmental problems and economic approaches towards their solution as well as knowledge about the relations between forest conservation and economic development.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Christiane Hubo
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

cf. examination regulations	
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1513: Monitoring of Forest Resources**	6 C 4 WLH
Learning outcome, core skills: Familiarize the students with the range of methods and techniques applied to forest monitoring in the preparation, planning, implementation and analysis phase. Objective is that the students are eventually in the position to carry out their own monitoring projects, and that they have the criteria to judge the quality of monitoring projects in general. Focus is on the target-oriented planning and the definition of the most appropriate sampling design and plot design that guarantees the generation of high-quality information for the decision makers in forestry.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Monitoring of forest resources (Lecture, Exercise) *Contents*: Forest monitoring is a forestry discipline that aims at the comprehensive and objective characterization of the forests as a production system and/or as an ecological system in a defined geographic area, in terms of status quo and changes. Forest inventories are the core element of monitoring and they generate data and information required by foresters, forest politicians and forest researchers to support decision making. The course module “Monitoring of forest resources” intends to familiarize the students with the range of methods and techniques applied to forest inventories in the preparation, planning, implementation and analysis phase. Objective is that the students are eventually in the position to carry out their own monitoring projects of forests and related resources, and that they know the criteria to judge the quality of monitoring projects in general. Focus is on the target-oriented planning and the definition of the most appropriate sampling design and plot design that guarantees the generation of high-quality information for the decision makers in forestry. That includes comprehensive presentation of statistical sampling. Examples of small and large area inventories and monitoring are presented and critically analysed. The important remote sensing applications for forest monitoring are not dealt with in detail in this module, as this topic is covered in other modules; but the relevance of integrated inventories (combining field sampling and remote sensing) is addressed. The development of forest inventories towards integrated “landscape inventories”, “multi-resource inventories”, “tree inventories” is also addressed of this course. Prerequisites: Sound basis in “Forest mensuration” and basic statistics.	4 WLH
Examination: Written exam (120 minutes)	6 C
Examination requirements: Target-oriented planning and the definition of the most appropriate sam-pling design and plot design that guarantees the generation of high-quality information for decision makers in forestry and related fields. In-troductory knowledge about remote sensing imagery (aerial photographs and satellite imagery) as one of the data sources employed in forest inventories. The development of forest inventories towards integrated "landscape inventories", "multi-resource inventories", "tree inventories". The students	

should be in the position to plan and carry out their own inventory projects, and that they have the criteria to judge the quality of inventory projects of others.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christoph Kleinn
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1514: Forest utilization and wood processing**	6 C 4 WLH

Learning outcome, core skills: Knowledge of technolgical relevant wood properties of important commercial timbers. Technology of major forest products in tropics (lumber, veneer, plywood, wood-based panels, pulp and paper) and their significance for forest utilisation. Enables students to analyse situations where forest operations take place and to select and quantify the optimal course of action. It puts forest operations into the broader context of society and forest ecosystems and stresses the human factor involved. Emphasis is directed to systems analysis and long-term perspectives	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Forest utilization and wood processing (Lecture) *Contents*: The modul consists of two parts: Work Systems and Methods in Forest Utilization. It puts forest operations into the broader context of society and forest ecosystems and stresses the human factor involved. Emphasis is directed to systems analysis and long-term perspectives. Contents: Overview of the role of forestry, forest products, forest areas, removals and general tendencies as basic information. The importance of the human factor: indigenous knowledge, training, ergonomics, occupational safety and health, work studies. Basic elements of road planning, construction and maintenance. Fuelwood, simple methods for charcoal production. Harvesting technologies: overview, reduced impact logging, case studies. Technologies outside harvesting. Appropriate technologies. Cost control in forest operations. Recent developments (information technology, GIS, logistics).	4 WLH
Examination: Written examination (120 minutes)	6 C

Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. forest. Gerhard Büttner
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1521: Ecopedology of the tropics and suptropics**	6 C 4 WLH
Learning outcome, core skills: General understanding of the most important aspects of tropical and subtropical soils, their occurrence, genesis, geography, properties and use. Understanding the principles of the international FAO soil profile description and classification.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Ecopedology of the tropics and subtropics (Lecture) *Contents*: Part I: General introduction in soils of the tropics and subtropics, their functions, genesis, geography and properties. Objective: general understanding of the most important aspects of tropical soils, their occurrence, genesis, properties and use. The following topics will be discussed: Introduction; Climate, water and vegetation; Weathering and weathering products, clay minerals; Soil organic matter, C and N dynamic; Soil chemical reactions, variable charge; Soil forming processes and development of soils; Water and nutrient cycling of land use systems; Tropical shield areas (example: Amazon basin); Arid shields and platforms (example: West Africa); Tropical mountain areas (example: Andes); Fluvial and coastal areas in the tropics (example: coastal areas in Asia). Part II: Introduction in the description and classification of soils, using in international system (FAO). Objective: understanding the principles of the FAO soil profile description and classification. The course consists of introductory lectures in which the principles of the FAO soil description and classification will be explained. This knowledge will be practiced using examples of soil profiles from different tropical countries. The second part consists of a practical week during which soil profile descriptions and evaluations will be exercised in the field. We will visit three contrasting sites around Göttingen where a site and soil description will be made. The work will be done in small groups. Students discuss their results in a report.	4 WLH
Examination: Term paper (10 pages max.) and written exam (2 hours)	6 C
Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1522: Project planning and evaluation**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
“Political evaluation”: Insights into the political framework of evaluation and the power and information based processes which drive any procedure of evaluation and application of the results in practice. The students conduct a case study in political evaluation based on literature and an interactive game. **“Evaluation of rural development projects and policies”:** In cooperation with the chair of „International Food Economics and Rural Development” this submodule teaches and trains the standard methods for the evaluation of rural development projects and policies. In particular, this includes impact assessment as well as cost-benefit analysis. The students learn how to use the methods and instruments and recognise advantages and limitations of the different evaluation techniques. A deeper understanding of the subject-matter is achieved by examples presented by guest lecturers and practitioners.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Political evaluation (Lecture)	1 WLH
2. Evaluation of rural development projects and policies (Lecture, Seminar)	3 WLH
Examination: Written examination (90 minutes)	6 C

Examination requirements:	
Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Bernhard Möhring
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1523: Biometrical research methods**	6 C 4 WLH
Learning outcome, core skills: Understanding and application of basic techniques of descriptive and confirmative statistics, as well as basic experimental designs and sampling techniques. Analysis of experimental data sets by an appropriate statistical programme package (at present: Statistica). Skills in describing and estimating forest stand parameters, forest structure and tree shape, and modelling of forest growth and development.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Biometric data analysis and experimental design (Lecture, Exercise)	2 WLH
2. Forest dynamics (Lecture, Exercise)	2 WLH
Examination: PC based written exam (120 minutes)	6 C
Examination requirements: Understanding and application of basic techniques of descriptive and confirmative statistics, as well as basic experimental designs and sampling techniques. Analysis of experimental data sets by an appropriate statistical programme package. Quantitative methods to describe forest density, forest structure and tree morphology, modelling tree growth, calculating sustainable harvests for even-aged and continuous cover forests and the biological role of insects in forest ecosystems.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Forst.1524: Biotechnology and forest genetics**	6 C 4 WLH
Learning outcome, core skills: Biotechnology is a fast developing field with many aspects and options in efficient and environmentally friendly bioresource production and utilization of bioresources including plant biomass. Sustainable management of tropical forests requires an understanding of the spatial and temporal dynamics of genetic information both in natural and man-made tropical forest ecosystems. The teaching module gives introductory lectures into biotechnology and into forest genetics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Biotechnology (Lecture) *Contents*: Students will be introduced into subjects of microbiology, biochemistry and molecular biology being basics for biotechnology. With the gained knowledge, modern biotechnological applications in the forest and the wood industry sectors and the progress of biotechnological biomass conversion will be discussed, as well as other environmental problems that might be solved by biotechnological approaches on industrial scales and, particularly in tropical countries, also by small family business.	2 WLH
Examination: Oral examination (approx. 15 minutes)	3 C

Course: Tropical forest genetics (Lecture) *Contents*: Basic principles of population genetics are introduced, factors shaping genetic diversity of tropical forest species are discussed with emphasis on the reproduction system of tropical forest plants, and genetic diversity patterns of tropical forest trees are described. Main applications of forest genetics are mentioned: provenance research and tree breeding, genetic implications of forest management, forest reproductive material, and conservation of forest genetic resources.	2 WLH
Examination: Oral examination (approx. 15 minutes)	3 C

Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ursula Kües
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

cf. examination regulations	
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1601: Bioclimatology and global change**	6 C (Anteil SK: 6 C) 4 WLH

Learning outcome, core skills: Scientific basis of climate and climate change, trace gas budgets of soils and whole ecosystems and the potential to sequester carbon and nitrogen in managed and unmanaged terrestrial ecosystems.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Bioclimatology and global change (Lecture) *Contents*: The module "Bioclimatology and Global Change" will introduce the students to the global climate system and its interaction with the biosphere. A lecture course will focus on the scientific basis of climate and climate change covering basic physical and chemical processes governing the climate system, climate zones, modelling as well as global and regional climate phenomena with a focus on tropical climates. A seminar course will highlight trace gas budgets of soils and whole ecosystems and their potential to sequester carbon and nitrogen in managed and unmanaged terrestrial ecosystems and their vulnerability to climate change. Using journal literature the students will work out oral presentations concerning current research topics concerning the global climate system and its interaction with the biosphere.	4 WLH
Examination: Written exam (90 minutes) and oral presentation (approx. 20 minutes)	6 C

Examination requirements: Understanding the most relevant processes at the biosphere-atmosphere interface and of biogeochemical cycles. Being able to find, read, evaluate, and present scientific literature related to Global Change.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Alexander Knohl
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1602: Dryland Forestry and Methods in Silviculture**	6 C 4 WLH
Learning outcome, core skills: Knowlegdge of the specifics of dryland forestry. Students will learn to use and apply different plant ecological and silvicultural methods.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Dryland forestry and methods in silviculture (Lecture, Exercise, Seminar) *Contents*: The lecture focuses on landuse options with special emphasis on the management of dry deciduous forests on a global scale. With 30% share of global land surface drylands play an important role in terms of ecological and economical aspects and require a specific way of management. The second focus of this module is the application of different plant ecological and silvicultural methods, especially for the analysis of gap dynamics. Management of tropical forest is largely based on the extraction of single large trees that create canopy gaps. In the seminar, we analyze predictions of ecological theory for tree establishment in forest gaps and will do an empirical study on regrowth characteristics in gaps of a species rich temperate forest. The method spectrum will include field measurements of canopy openness, leaf area, soil moisture, leaf water potential and leaf traits.	4 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (10 pages max.)	6 C
Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Dirk Hölscher
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1605: Forest Protection and Agroforestry**	6 C 4 WLH
Learning outcome, core skills: Assessment of forest protection problems and available methods of insect or pathogen control with special emphasis on sustainable methods. Basic understanding of agroforestry systems in the tropics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Forest protection and agroforestry (Lecture) *Contents*: Forest protection is aimed at protecting natural, near natural and plantation forests from disease and pests. Diseases do include abiotic diseases (damage from lack and excess of nutrients, fire, drought pollution, etc.) and biotic diseases caused by microorganisms including viruses and protozoa, and parasitic plants. Forest protection deals also with damage from animal pests, meaning arthropods and there specially insects, but also damage from mammalians. The matter is presented in a concept of integrated pest and disease management, here pests and diseases affecting specific tree species (mahogany, teak, Pinus, Dipterocarpaceae, Acacia, Eucalyptus, etc.) are treated together. Beside this core lectures. A prerequisite for the lectures and practical training, is knowledge of basic subjects of phytomedicine. However, if necessary, missing, incomplete and not up to date knowledge may be supplemented in lectures such as: Overview of abiotic diseases, theoretical approach to integrated pest and disease management, biological, bio-technical and chemical control of pests and diseases. The main focus of the module is explanation of specific (and for forest protection important) features of the individual tree species and/or forest types, diagnostic of the disease and pest attack and explanation of strategies for the integrated management of the disease or pest. Possible control strategies include. Experiences of the lecturers are in Germany and abroad (South and Central America, North Africa and South East Asia) and advice can be provided also in Spanish. silvicultural based measures, i. e. displacing the attack of diseases and pests by changing planting distance, managing shadow, managing thinning, establishing mixed stands, change of logging practices. Reducing spread of disease or pest by eradication of individual trees or group of trees or certain areas of the forest (hot spots) or manual collecting of specific insect stages. Genetic based measures i. e. resistant species, subspecies, f. sp., varieties and different provenience, and, if available, genetic engineered plants trimmed for resistance to diseases and pests. Chemical oriented plant protection. Applied according to the principles of integrated pest management, which includes economic threshold, consideration of the residue problems and health of the applying forester. Basic knowledge are required, but may be supplied in a specific lectures. Biological and biotechnical oriented plant protection. In this context experiences and possibilities of applying these measures in the field are being discussed. Specific examples are treated and possible approaches to new problems are discussed. The influence of different factors (including the above listed approaches) on the biological and biotechnical plant protection are considered. Basic knowledge is required, but may be supplied in specific lectures. Agroforestry systems are land-use systems and practises in which woody perennials are deliberately grown	4 WLH

on the same land management unit as crops and/or animal husbandry, either in some form of spatial arrangement or in a time sequence, and in which there is a significant interaction between the woody perennials and the crops or animals. Starting with general considerations in agroforestry systems, a selection of systems in which trees or other woody perennials play an important role are discussed: The classical Taungya System, the tumpangsari system in Java, the Malang and Magelang system, the Juhm system of Nagaland, different home and forest gardens of S-E-Asia. In detail discussed are the role of trees in agroforestry systems and a selection of suitable tree species for agroforestry systems.	
Examination: Written exam (120 minutes)	6 C

Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1606: Forestry in Germany**	6 C 4 WLH
Learning outcome, core skills: Understanding of forestry and related industries in Germany.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Forestry in Germany (Excursion, Seminar) *Contents*: Important aspects of German Forestry are introduced to foreign students interested in the forest management as practised in Germany as well as the wood-processing industry. Contents are forest management, silviculture, forest utilization, labor science and prozess technology, forest econmics, tree improvement and genetics, forest inventory and remote sensing (forest management inventories in Germany, the German National Forest Inventory, applications of remote sensing in forestry planning in Germany) The module provides a basic understanding of the forest management in Germany including actual trends and perspectives. It is strongly suggested for foreign students who are going to undertake their project in Germany (Project: 70130 "Managing sustainable forestry systems in Germany"). The module includes various excursions.	4 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (15 pages max.)	6 C
Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.Forst.1607: Biodiversity, NTFP's and wildlife management	6 C 4 WLH
Learning outcome, core skills: Course objectives: Non-timber forest products (NTFPs) are important sources of income and nutrition in many regions. While the harvesting of these products is commonly based on traditional knowledge, a systematic approach to a sustainable management is often not in place. Moreover the use of NTFPs is often in conflict with other forest use (e.g. timber extraction, protected areas) or extraction of NTFPs exceeds sustainable levels. A rigors ecological / economic assessment of the resource thus represents a first important step towards the understanding and development of sustainable management systems. A wide range of NTFPs is introduced that are relevant in different regions of the world. In the second part of this module, we will discuss recent topics in international forest conservation. Course contents: The taxonomy, ecology, and economic and cultural importance of major NTFPs are described. Different assessment and monitoring approaches are presented and discussed. The course covers the basic concepts of wildlife ecology and conservation, including habitat requirements, population dynamics, and predator-prey relationships. Commonly-used methods for estimating wildlife-habitat relationships and population parameters will be explained through practical exercises. Examples from the published literature will then serve to illustrate the use of these basic concepts and method for the sustainable management of wildlife resources. These examples will include case studies dealing with population estimation, setting harvesting quote, mitigating human-wildlife conflicts, and identifying priority areas for habitat conservation. The presentation of different nature conservation strategies and nature reserve systems in Europe and Non-European foreign countries qualify and enlarge the knowledge of nature conservation. The contents comprises topics of assessment of biodiversity, international categories of protected areas and assessment of conservation status, conservation problems and priorities in the temperate and boreal forests and in tropical forests as well, hot spots, deforestation, selective logging, rehabilitation of exploited forests, poaching, national parks, ecotourism, conservation problems in grasslands, hunting tourism, economic use of game resources, conservation problems of islands and exotic species. Teaching and learning methods: Lectures; paper presentations by students on specific topics; Competences acquired: The students are familiar with a wide range of NTFPs and wildlife and have a good command of the relevant assessment and monitoring techniques.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Non timber forest products and biodiversity conservation (Lecture, Exercise)	2 WLH
2. Wildlife management (Lecture, Exercise)	2 WLH
Examination: Oral presentation (approx. 25 minutes) and oral exam (approx. 10 minutes)	6 C

Examination requirements: Familiarity with a wide range of NTFPs and wildlife; good command of the relevant assessment and monitoring techniques.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Niko Balkenhol
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Forst.1609: Remote Sensing Image Processing with Open Source Software**	6 C 4 WLH
Learning outcome, core skills: This combined lecture and lab makes the student familiar with principles of digital image processing and GIS integration, with a focus on applications in forestry and ecology. The software GRASS is used which is freely available as open source software. Students are encouraged to bring their own notebook computers, if available.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Remote sensing image processing with open source software (Lecture, Exercise) *Contents*: Notions of remote sensing and digital imagery are briefly addressed. General characteristics of open source software are presented. The software GRASS is introduced and being used for typical tasks of digital image processing of remote sensing imagery, such as image enhancement, geometric corrections, cloud masking, 3D visualization, vector to raster transformation, and eventually image classification. If teaching progress allows, case studies and the integration of sampling and image interpretation are presented and discussed.	4 WLH
Examination: Oral exam (approx. 15 minutes) and practical exam (approx. 15 minutes)	6 C
Examination requirements: The students should give evidence that they know the application-oriented technical bases of remote sensing and the possibilities and limitations of remote sensing when applied to problems of forest management and conservation. They shall also prove that they have acquired sufficient insight and skills in using the software of the lecture so that they are able to solve basic image processing problems and they should give evidence that they can systematically approach larger problems.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christoph Kleinn
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Forst.1610: Tropical dendrology and wood science**	6 C 4 WLH
Learning outcome, core skills: Tropical Dendrology objectives: Assessment of ecological characteristics and management of major tree species. Students will learn how to give an oral presentation. Wood Science objectives: Ability to identify several selected tropical and subtropical tree species by means of macroscopical key-feature characteristics as well as to assess their technologically relevant wood properties and possible uses.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Tropical dendrology** (Lecture, Exercise) *Contents*: In the tropical rainforest 50-60.000 tree species occur. Of course, it is not possible to know all of them including their ecological characteristics. However, in the course on Tropical dendrology we will present important families to which tropical trees belong. Furthermore, we will elaborate physiological principles with respect to water, carbon and nutrient turnover by trees, and focus on the possibilities of a functional classification of trees. For selected tree species we will analyse the ecological characteristics, management options and the use in more detail.	2 WLH
2. Wood science (Lecture, Exercise) *Contents*: In the Wood Science course the students learn to understand the variability of wood anatomical structure and features of selected tropical and subtropical tree species. The identification of important tropical and subtropical tree species will be carried out by using anatomical key-descriptions of sapwood and heartwood. Furthermore, the students obtain the following information to the selected tree species: Description of distribution area, technologically-relevant wood properties, wood processing and utilization possibilities.	2 WLH
Examination: Oral presentation (approx. 20 minutes) with written outline (max. 20 pages)	6 C
Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Dr. h. c. Frantisek Hapla
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**

Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.Forst.1611: Exercises in Forest Inventory**	6 C 4 WLH
Learning outcome, core skills: The students shall learn to design, to implement, to document and to cause forest inventory projects autonomously and on a scientific basis. Further on, they shall develop the abilities to optimize and to develop measuring methods related to forests. Therefore, it is crucial to handle common measuring instruments and methods safely.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Exercises in forest inventory (Lecture, Exercise) *Contents*: • Short repetition about the use of instruments for measuring DBH, upper diameters and heights. • Planning, preparation and implementation of a sample based forest inventory, including the designing of an inventory instruction. • Data management (Excel) and analysis after given tasks. • Formulating a project report. • Presentation of results in small groups within a seminar for examination.	4 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (15 pages max.)	6 C
Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christoph Kleinn
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.Forst.1615: Forest growth and tree-based land use in the tropics**	6 C 4 WLH

Learning outcome, core skills: Understanding of forest dynamics and growth research approaches in the tropics. Participants will become familiar with sampling, measurement, and analysis methods for age determination and increment measurement of trees and forest stands. The seminar will enable students to direct discussions on scientific topics.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Forest growth and tree-based land use in the tropics (Lecture, Exercise) *Contents*: The lecture include the following topics: geographical distribution of the tropics and their climatological characterization, dendrological and site characteristics of forests types, structure and dynamics of forests, status of tropical forests and situation of deforestation, climate growth relations of trees and stands, wood anatomical features of selected tree species, implications of growth studies on sustainable management systems and carbon flux estimations in tropical forests. Thes seminar focuses on the impact of natural and human perturbations on tropical forest ecosystems. Disturbances such as fire, harvesting, land-uses change and global warming to tropical forests will be evaluated. Through a series of student-led discussions founded on case studies from the lecture 'Tropical forest ecology and silviculture' and recent literature, we will address the effects of perturbations on ecological characteristics of forests such as net primary productivity, nutrient cycling and plant communities.	4 WLH
Examination: 2 Subexams: Written exam (60 minutes) and term paper (15 pages max.)	6 C

Examination requirements: Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Sophie Graefe
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.HEG.12: Hydrogeology I**	8 C 6 WLH

Learning outcome, core skills: This module is intended to convey the fundamentals of the theory of groundwater flow and transport and to apply them in practical exercises in the field and in the laboratory. The students should be able to organise and conduct test procedures as well as to assess the specific hydrogeological site conditions. The contents of the module comprise the hydrological water balance, groundwater recharge estimation techniques, groundwater hydrology, pumping test evaluation and principles of solute transport. Relevance of this fundamental material is illustrated with examples from the hydrogeological practice, e.g. water resources exploration, and groundwater remediation. A field seminar will introduce the students into the most important field techniques of the daily practice of a hydrogeologist. During the “Advanced Hydrogeological Investigation Techniques” course, new assessment techniques for the hydraulic characterisation of aquifers are presented and demonstrated using practical examples. The advanced course on “Aquifersystems” will concentrate on the specifics of fractured aquifers and the particulars of the large variety of aquifer systems in Northern Germany. They can be regarded as representative for a large number of aquifer types.	**Workload:** Attendance time: 84 h Self-study time: 156 h

Courses:	
1. Introduction to Hydrogeology (Lecture, Exercise)	3 WLH
2. Advanced Hydrogeological Investigation Techniques (Lecture)	1 WLH
3. Geology of Aquifer systems (Lecture, Excursion)	1 WLH
4. Well Design and Construction (Lecture)	1 WLH
Examination: Written examination (60 minutes)	8 C

Examination requirements: Theory and practice of groundwater flow and solute transport processes, implementation in the field.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. Jannes Kordilla Prof.Dr. Martin Sauter
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.13: Hydrogeochemistry**	6 C 5 WLH

Learning outcome, core skills:	**Workload:**
The module intends to convey an understanding for the role of chemical processes in water-rock interaction. The first lecture introduces the essential thermodynamics to understand basic and coupled electrolyte equilibria (i.e. redox processes, acid/base reactions, solubility, complexation, ion exchange) in the aquatic environment and is accompanied by simple and complex calculations of real world problems as well as coursework. The second lecture focuses on the classification of organic compounds and pollutants in the subsurface. Relevant properties are discussed together with property-structure-relationships. The environmental and subsurface behaviour of organic compounds is introduced in terms of relevant distribution equilibria and kinetically controlled processes. Complex examples are provided partially as coursework helping to apply gained knowledge. The isotope hydrology course is intended to provide the techniques to differentiate between different types of water of variable origins. Fundamentals of fractionation effects and the limitations of the methods are discussed.	Attendance time: 70 h Self-study time: 110 h

Courses:	
1. Inorganic Hydrogeochemistry (Lecture)	2 WLH
2. Organic Hydrogeochemistry (Lecture)	2 WLH
3. Exercise in Hydrogeochemistry (Exercise)	1 WLH
Examination: Written examination (90 minutes)	6 C

Examination requirements:	
Knowledge about basic inorganic equilibrium water chemistry, water chemistry data interpretation, contaminant classes, basic organic chemistry, structure-properties relationships for organic compounds, distribution equilibria, isotope hydrology	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in chemistry
Language: English	**Person responsible for module:** PD Dr. rer. nat. Tobias Licha Prof. Dr. Martin Sauter
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.14: Hydrology and GIS**	6 C 6 WLH
Learning outcome, core skills: The first course in submodule 1 gives an overview about the fundamentals of surface water hydrology. The main topics are precipitation, evapotranspiration, snow, runoff generation and soil water. Furthermore, the course provides theoretical concepts of models and related exercises. The second course comprises a practical introduction to hydrological models, the delineation of watersheds using GIS, the hydrological model setup, sensitivity analysis, calibration and validation. The third course concerns urban hydrology and groundwater management issues, concentrating on the science and engineering of urban groundwater, including for example the impact of urban development on groundwater, sustainable management and protection of groundwater resources in urban environments, and innovative management concepts. The first course in submodule 2 provides knowledge about basic GIS techniques (e.g. spatial data models, data input techniques, spatial analysis) applied in hydrologic, geological and environmental studies. Students gain practical skills by computer exercises with state of the art software. The second course offers the opportunity to become acquainted with basic remote sensing techniques (correction, composites, ratios, indices, PCA, classification) using common multispectral datasets. Students will mainly work on practical exercises that focus on the application of digital image processing in geological, hydrologic and environmental case studies.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Courses:	
1. Introduction to Surface Hydrology (Lecture, Exercise)	1 WLH
2. Surface Water Modeling (Lecture, Exercise)	1 WLH
3. Urban Hydrology and Groundwater Management (Lecture, Exercise)	1 WLH
Examination: Written examination to course 1 and 2 (45 minutes) **Examination prerequisites:** Course 3: Term paper (max. 15 pages) **Examination requirements:** Understanding of basic principles and application of state of the art methods in surface water and urban hydrology.	3 C
Courses:	
1. Geographic Information Systems (GIS) (Exercise)	2 WLH
2. Applied Remote Sensing Techniques (Exercise)	1 WLH
Examination: Presentation of the project work (approx. 10 min.) **Examination requirements:** Practical application of GIS and Remote Sensing techniques on provided datasets.	3 C
Examination requirements:	

Understanding of basic principles and application of state of the art methods in surface water hydrology and applied statistics.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowlegde in Geology, Computer Literacy, Cartography, Geography
Language: English	**Person responsible for module:** Dr. rer. nat. Bianca Wagner
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.22: Groundwater Modeling I**	6 C 5 WLH
Learning outcome, core skills: This module introduces the student to the commonly used mathematical tools as well as to state of-the-art numerical groundwater modeling techniques, including visualization of the results. Groundwater modeling allows a consistent assembly of multiple types of data from laboratory and field investigations, environmental system analysis, process understanding, planning of water management and remedial activities, risk assessment, decision making etc.. The first and second course focus on the numerical modeling of flow and non-reactive as well as reactive transport in porous media (aquifers). It includes topics such as model design, mathematical process formulation (process equations) and numerical methods for solving the governing equations. Simple modeling problems will be discussed and exercised by the students using computer codes in tutorials to complement the presentations given in the lecture. The third course deals with special advanced modeling techniques. The focus will be on basin scale integrated hydrosystem modeling, covering porous and fractured media, saturated and unsaturated zones, surface water - groundwater interaction, surface water modeling, hillslope hydrological aspects, including reactive contaminant transport. Students will gain hands on experience with models through computer exercises.	**Workload:** Attendance time: 70 h Self-study time: 110 h
Courses: **1. Groundwater Flow Modeling** (Lecture, Exercise) **2. Groundwater Transport Modeling** (Lecture, Exercise, Seminar)	 2 WLH 2 WLH
Examination: Term Paper (max. 10 pages) **Examination prerequisites:** Compulsory attendance in the exercises	5 C
Course: Advanced Modeling Techniques (Lecture, Exercise)	1 WLH
Examination: Presentation of Course Work (approx. 15 min.), not graded **Examination prerequisites:** Compulsory attendance in the exercise	1 C
Examination requirements: Knowledge about theoretic background and state of the art techniques in groundwater modelling, understanding of main concepts of integrated hydrosystem modelling and practical skills.	

Admission requirements: M.HEG.11, M.HEG.12, M.HEG.13	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr.-Ing. habil. Thomas Ptak-Fix Prof. Dr. Martin Sauter
Course frequency: each summer semester	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.24: Georeservoirs I - Processes and Characterization**	6 C 4 WLH
Learning outcome, core skills: This module intends to convey a general understanding for the relevant processes and the general concepts involved in the exploitation of geothermal energy. The module is subdivided into “Deep Geothermics”, concentrating on power and heat production at large depths (> 4000m) “Shallow Geothermics”, dealing with heat extraction at shallow depths (< 500m), and the illustration of the use of geothermal energy with case studies. For the assessment and exploitation of geothermal energy, general knowledge of groundwater flow and transport is a prerequisite, provided in modules elsewhere. Course contents of this module comprise some basic principles, the regional assessment of the geothermal potential in Germany and Europe, required site conditions for economical exploitation, generally employed testing procedures, economical assessment methods, fractures and faults, fluid flow in fractured systems, stimulation methods.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Fluid flow, Mass and Heat Transport** (Lecture, Exercise)	 2 WLH
2. Geochemistry and Geomechanics (Lecture, Exercise)	2 WLH
Examination: Written examination (120 minutes)	6 C
Examination requirements: Prerequisites for the economical exploitation of shallow and deep geothermal energy, design of geothermal plants.	

Admission requirements: M.HEG.11, M.HEG.12, M.HEG.13	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. Bettina Wiegand Dr. Iulia Ghergut
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.310: Groundwater Modeling II**	8 C 5 WLH
Learning outcome, core skills: The module “Georeservoirs II” deals with processes in georeservoirs (geothermal, energy storage, CO2-storage and hydrocarbons), their identification and quantification of process parameters. Processes in georeservoirs comprise hydraulic, thermal, mechanical and chemical processes as well as their coupling. The investigation of georeservoirs is one of the main research focuses in the Applied Geology and nowadays a highly relevant field in energy research issues. During the courses, the methods of the investigation, characterisation and modelling of georeservoirs shall be conveyed to the students, together with illustrations of practical examples of case studies. A field trip shall be conducted to geothermal plants and drilling sites.	**Workload:** Attendance time: 70 h Self-study time: 170 h
Courses:	
1. Modeling of unsaturated Zone Processes (Lecture, Exercise)	2 WLH
2. Simulation of Flow and Transport in Fractured and Karstified Aquifers (Lecture, Exercise)	2 WLH
3. Reactive Transport Processes (Lecture, Exercise)	1 WLH
Examination: Written examination (90 minutes)	8 C
Examination requirements: Prerequisites of the understanding of reservoir functioning and prediction of their future dynamics.	

Admission requirements: M.HEG.11, M.HEG.12, M.HEG.22	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. Jannes Kordilla
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.320: Georeservoirs II - Environments and Applications**	5 C 4 WLH
Learning outcome, core skills: The module “Georeservoirs II” deals with processes in georeservoirs (geothermal, energy storage, CO_2-storage and hydrocarbons), their identification and quantification of process parameters. Processes in georeservoirs comprise hydraulic, thermal, mechanical and chemical processes as well as their coupling. The investigation of georeservoirs is one of the main research focuses in the Applied Geology and nowadays a highly relevant field in energy research issues. During the courses, the methods of the investigation, characterisation and modelling of georeservoirs shall be conveyed to the students, together with illustrations of practical examples of case studies. A field trip shall be conducted to geothermal plants and drilling sites.	**Workload:** Attendance time: 56 h Self-study time: 94 h
Courses:	
1. Deep Geothermics (Lecture, Exercise)	2 WLH
2. Georeservoirs Engineering (Lecture, Exercise)	2 WLH
Examination: Written examination (60 minutes)	5 C
Examination requirements: Prerequisites of the understanding of reservoir functioning and prediction of their future dynamics.	

Admission requirements: M.HEG.12, M.HEG.22, M.HEG.24	**Recommended previous knowledge:** Good knowledge of hydraulic and tracer test methods and insight into coupled THMC processes.
Language: English	**Person responsible for module:** Dr. rer. nat. Iulia Ghergut
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.330: Advanced methods in Hydrogeology**	8 C 5 WLH

Learning outcome, core skills: The first course focuses on innovative investigation and monitoring techniques. Both integral and high resolution point scale, non-invasive and invasive investigation techniques are presented, and scale-heterogeneity relationship issues are discussed. The second course addresses the problem of salinity in groundwater, characterisation, mapping, modelling and the management of groundwater resources in presence of salinity, including coastal aquifers and inland aquifers with saline water bodies. The third course provides knowledge about remote sensing techniques (e.g. remote sensing scanning techniques, image processing, interpretation) applied in hydrologic and environmental studies. Finally the module is supplemented with the basics of well construction and completion.	**Workload:** Attendance time: 70 h Self-study time: 170 h

Courses:	
1. Isotope Hydrology (Lecture, Exercise)	2 WLH
2. Application of Indicators and Tracers (Lecture, Exercise)	1 WLH
Examination: Written examination (90 minutes)	5 C

Course: Investigation Techniques and Monitoring (Lecture, Exercise)	2 WLH
Examination: Written examination (60 minutes)	3 C

Examination requirements: Investigation and monitoring techniques, seawater intrusion control, remote sensing techniques, basic principles of well construction.	

Admission requirements: M.HEG.11, M.HEG.12, M.HEG.13, M.HEG.21, M.HEG.22	**Recommended previous knowledge:** Basic knowledge in Hydrochemistry, Geology, Hydrogeology und Transport processes
Language: English	**Person responsible for module:** PD Dr. rer. nat. Tobias Licha Prof. Dr.-Ing Thomas Ptak-Fix
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.HEG.340: Selected Topics in Hydrogeology**	3 C 2 WLH
Learning outcome, core skills: Lecture topics vary depending on current innovative research trends in hydrogeology. Courses for example can include those given below: 1. Operations research applications in the field of integrated water resources management (IWRM). The lecture specifically treats: multi-criteria-analysis and multi-objective optimization procedures and their application to specific IWRM topics, such as irrigation planning and management, surface water reservoir planning and operation or Managed Aquifer Recharge. The application of decision support systems in IWRM is discussed, too. Social, political, legal and institutional aspects of IWRM, transboundary and conflict management are treated on an introductory level as well. A part of the course will be organized as seminar organized by the students. 2. The problem of salinity in groundwater, characterization, mapping, modelling and the management of groundwater resources in the presence of salinity, including coastal aquifers and inland aquifers with saline water bodies. The courses can be modified ad hoc to take into account current new topics and scientific methods or to integrate specialised expertise of visiting scientists.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Courses:	
1. Operations Research in IWRM (Lecture, Exercise)	1 WLH
2. Saline Groundwater (Lecture, Exercise)	1 WLH
Examination: Written examination (60 minutes)	3 C
Examination requirements: Knowledge as presented in the course on selected topics in the field of integrated water resources management and salinity problems in groundwater.	

Admission requirements: M.HEG.11, M.HEG.12, M.HEG.13	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Martin Sauter
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.Inf.1120: Mobile Communication**	5 C 3 WLH

Learning outcome, core skills: On completion of the module students should be able to: • explain the fundamentals of mobile communication including the use of frequencies, modulation, antennas and how mobility is managed • distinguish different multiple access schemes such as SDMA (Space Division Multiple Access), FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access), CDMA (Code Division Multiple Access) and their variations as used in cellular networks • describe the history of cellular network generations from the first generation (1G) up to now (4G), recall their different ways of functioning and compare them to complementary systems such as TETRA • explain the fundamental idea and functioning of satellite systems • classify different types of wireless networks including WLAN (IEEE 802.11), WPAN (IEEE 802.15) such as Bluetooth and ZigBee, WMAN (IEEE 802.16) such as WiMAX and recall their functioning • explain the challenges of routing in mobile ad hoc and wireless sensor networks • compare the transport layer of static systems to the transport layer in mobile systems and explain the approaches to improve the mobile transport layer performance • differentiate between the security concepts used in GSM and 802.11 security as well as describe the way tunnelling works	**Workload:** Attendance time: 42 h Self-study time: 108 h

Course: Mobile Communication (Lecture, Exercise)	3 WLH
Examination: Written exam (90 min.) or oral exam (approx. 20 min.) **Examination requirements:** Fundamentals of mobile communication (frequencies, modulation, antennas, mobility management); multiple access schemes (SDMA, FDMA, TDMA, CDMA) and their variations; history of cellular network generations (first (1G) up to current generation (4G) and outlook to future generations); complementary systems (e.g. TETRA); fundamentals of satellite systems; wireless networks (WLAN (IEEE 802.11), WPAN (IEEE 802.15) such as Bluetooth and ZigBee, WMAN (IEEE 802.16) such as WiMAX); routing in MANETs and WSNs; transport layer for mobile systems; security challenges in mobile networks such as GSM and 802.11 and tunneling;	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in telematics and computer networks
Language: English	**Person responsible for module:** Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1121: Specialization Mobile Communication**	5 C 3 WLH
Learning outcome, core skills: On completion of the module students should be able to: • recall the basic terms and definitions of wireless ad hoc networks, their history and name their basic application areas • describe the special characteristics of the physical layer of wireless ad hoc networks • differentiate the various media access control (MAC) schemes as used in wireless ad hoc networks; and name their challenges • explain the network protocols used in wireless ad hoc networks, reason the design decisions taken in this context as well as classifying and comparing the different existing routing protocol approaches • identify the energy management issues in wireless ad hoc networks and classify existing energy management schemes • describe security challenges in ad hoc networks, threats and attacks and corresponding security solutions such as cryptography schemes, key management, secure routing protocols and soft security mechanisms • discuss the challenges on the transport layer in wireless ad hoc and sensor networks, compare them to existing protocols, classify them and discuss enhancements of TCP for wireless ad hoc networks • describe the challenges of wireless sensor networks (WSN) and explain the differences to wireless ad hoc networks • memorize the WSN architecture and topology, the used operating systems and the existing hardware nodes • discuss the optimization goals in WSNs, the used MAC protocols as well as the utilised naming and addressing schemes; additionally, describe the used approaches for time synchronization, localization and routing	**Workload:** Attendance time: 42 h Self-study time: 108 h
Course: Wireless Ad Hoc and Sensor Networks (Lecture, Exercise)	3 WLH
Examination: Written exam (90 min.) or oral exam (approx. 20 min.) **Examination requirements:** Terms, definitions and characteristics of wireless ad hoc networks; Network Layer used in wireless ad hoc networks (Physical, MAC, Network Layer, Transport, Application); Energy Management; Security Challenges, threats and attacks in wireless ad hoc networks and their counter measures (cryptographic schemes, key management, secure routing, soft security); architecture, topologies and characteristics of wireless sensor networks (WSNs) and the differences to ad hoc networks; WSN specifics (naming and addressing, synchronization, localization and routing)	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in telematics and computer networks
Language:	**Person responsible for module:**

English	Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen Module M.Inf.1122: Seminar on Advanced Topics in Telematics	5 C 2 WLH
Learning outcome, core skills: On completion of the module students should be able to: • critically investigate current research topics from the area of telematics such as bio-inspired approaches in the area of wireless communication or security attacks and countermeasures for mobile wireless networks • collect, evaluate related work and reference them correctly • summarize the findings in a written report • prepare a scientific presentation of the chosen research topic	**Workload:** Attendance time: 28 h Self-study time: 122 h
Courses:	
1. Network Security and Privacy (Seminar)	2 WLH
2. Security of Self-organizing Networks (Seminar)	2 WLH
3. Trust and Reputation Systems (Seminar)	2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) **Examination requirements:** The students shall show that • they are able to become acquainted with an advanced topic in telematics by investigating up-to-date research publications. • they are able to present up-to-date research on an advanced topic in telematics. • they are able to assess up-to-date research on an advanced topic in telematics. • they are able to write a scientific report on an advanced topic in telematics according to good scientific practice.	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in telematics and computer networks
Language: English	**Person responsible for module:** Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.Inf.1123: Computer Networks	5 C 2 WLH
Learning outcome, core skills: The students • have gained a deeper knowledge in specific topics within the computer networks field • have improved their oral presentation skills • know how to methodically read and analyse scientific research papers • know how to write an analysis of a specific research field based on their analysis of state-of-the-art research • have improved their ability to work independently in a pre-defined context	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Advanced Topics in Mobile Communications (Seminar)	2 WLH
Examination: Präsentation (ca. 30 Min.) und Hausarbeit (max. 15 Seiten) **Examination requirements:** Knowledge in a specific field of mobile communication; Ability to present the earned knowledge in a proper way both orally and in a written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1124: Seminar Computer Networks**	5 C 2 WLH
Learning outcome, core skills: The students • have gained a deeper knowledge in specific topics within the computer networks field • have improved their oral presentation skills • know how to methodically read and analyse scientific research papers • know how to write an analysis of a specific research field based on their analysis of state-of-the-art research • have improved their ability to work independently in a pre-defined context	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Seminar on Internet Technology (Seminar)	2 WLH
Examination: Präsentation (ca. 30 Min.) und Hausarbeit (max. 15 Seiten) **Examination requirements:** Knowledge in a specific field of internet technology; ability to present the earned knowledge in a proper way both orally and in a written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1127: Introduction to Computer Security**	5 C 4 WLH
Learning outcome, core skills: After successful completion of the modul students are able to • describe and apply symmetric-key cryptosystems • describe and apply public-key cryptosystems • apply and compare mechanisms for authentication and access control • explain attacks on different networks layers • apply and compare defenses against network attacks • identify vulnerabilities in software and use countermeasures • describe types and mechanisms of malware • apply and compare methods for intrusion and malware detection • describe and use honeypot and sandbox systems	**Workload:** Attendance time: 56 h Self-study time: 94 h
Course: Introduction to Computer Security (Lecture, Exercise)	4 WLH
Examination: Klausur (120 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** Successful completion of 50 % of the exercises **Examination requirements:** Symmetric-key and public-key cryptosystems; mechanisms for authentication and access control; network attacks and defenses; software vulnerabilities and countermeasures; detection of intrusions and malicious software	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konrad Rieck
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1128: Seminar Intrusion and Malware Detection**	5 C 2 WLH

Learning outcome, core skills: After successful completion of the modul students are able to • explain current problems of intrusion/malware detection • summarize and present an approach for intrusion/malware detection • discuss theoretical and practical details of the approach • identify and review related worka • analyse advantages and shortcomings of related approaches • propose possible solutions and extensions	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Intrusion and Malware Detection (Seminar)	2 WLH
Examination: Vortrag (ca. 30 Min.) mit schriftlicher Ausarbeitung (max. 10 Seiten) **Examination requirements:** Intrusion and malware detection; detailed discussion of one approach; comparison with related work; written report; oral presentation	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konrad Rieck
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1129: Social Networks and Big Data Methods**	5 C 2 WLH

Learning outcome, core skills: The students • are familiar with basic concepts of social networks • know how to methodically read and analyse scientific research papers • have enriched their practical skills in computer science with regards to analysis of big data applications • have improved their ability to work independently in a pre-defined context • have improved their ability to work in diverse teams	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Social Networks and Big Data Methods (Exercise, Seminar)	2 WLH
Examination: Term Paper (max. 20 pages) **Examination prerequisites:** Erreichen von mindestes 50% der Übungspunkte **Examination requirements:** Basic knowledge in social networks and data analysis; ability to transfer the theoretical knowledge to practical exercises; ability to present the earned knowledge in a proper written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures; advanced programming skills
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1130: Software-defined Networks (SDN)**	5 C 2 WLH
Learning outcome, core skills: The students • are familiar with the concepts of software defined networking (SDN) • know how to methodically read and analyse scientific research papers • have enriched their practical skills in computer networks with regards to SDN • know about practical deployability issues of SDN • have improved their ability to work independently in a pre-defined context	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Software-defined Networking (Exercise, Seminar)	2 WLH
Examination: Term Paper (max. 20 pages) **Examination prerequisites:** Erreichen von mindestes 50% der Übungspunkte **Examination requirements:** Knowledge in software-defined networking; ability to transfer the theoretical knowledge to practical exercises; ability to present the earned knowledge in a proper in a written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures; advanced programming skills
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.Inf.1150: Advanced Topics in Software Engineering	5 C 3 WLH
Learning outcome, core skills: The students • gain knowledge about an advanced topic in software engineering. The advanced topic may be related to areas such as software development processes, software quality assurance, and software evolution • become acquainted with the status in industry and research of the advanced topic under investigation • gain knowledge about methods and tools needed to apply or investigate the advanced topic	**Workload:** Attendance time: 42 h Self-study time: 108 h
Course: Construction of Reusable Software (Block course, Seminar) *Contents*: Topics which will be covered by lecture and associated seminar include • design patterns • frameworks • unit testing with the JUnit Framework • the Eclipse Framework • refactoring • design-by-Contract/Assertions • aspect-oriented programming (AOP)	3 WLH
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination requirements:** **Preliminary test** If the module is implemented by a lecture with exercises: • Development and presentation of the solution of at least one exercise (presentation and report) and active participation in the exercises If the module is implemented by a block lecture with an associated seminar: • Presentation of at least one topic in the associated seminar • Attendance in 80% of the seminar presentations **Exam** The students shall show knowledge about • the principles of the advanced topic under investigation • the status of the advanced topic under investigation in industry and research • the methods and tools for applying or investigating the advanced topic	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language:	**Person responsible for module:**

English	Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1151: Specialization Softwareengineering: Data Science und Big Data Analytics**	5 C 3 WLH
Learning outcome, core skills: The students • can define the terms data science, data scientist and big data, and acquire knowledge about the principle of data science and big data analytics • become acquainted with the life cycle of data science projects and know how the life cycle can be applied in practice • gain knowledge about a statistical and machine learning modelling system • gain knowledge about basic statistical tests and how to apply them • gain knowledge about clustering algorithms and how to apply them • gain knowledge about association rules and how to apply them • gain knowledge about regression techniques and how to apply them • gain knowledge about classification techniques and how to apply them • gain knowledge about text analysis techniques and how to apply them • gain knowledge about big data analytics with MapReduce • gain knowledge about advanced in-database analytics	**Workload:** Attendance time: 42 h Self-study time: 108 h
Course: Data Science and Big Data Analytics (Lecture, Exercise)	3 WLH
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** Successful completion of 50% of each exercise and the conduction of a small analysis project. **Examination requirements:** Data science, big data, analytics, data science life cycle, statistical tests, clustering, association rules, regression, classification, text analysis, in-database analytics.	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of statistics and stochastic.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1152: Specialization Softwareengineering: Quality Assurance**	5 C 3 WLH

Learning outcome, core skills: The students • can define the term software quality and acquire knowledge on the principles of software quality assurance • become acquainted with the general test process and know how it can be embedded into the overall software development process • gain knowledge about manual static analysis and about methods for applying manual static analysis • gain knowledge about computer-based static analysis and about methods for applying computer-based static analysis • gain knowledge about black-box testing and about the most important methods for deriving test cases for black-box testing • gain knowledge about glass-box testing and about the most important methods for deriving test cases for glass-box testing • acquire knowledge about the specialties of testing of object oriented software • acquire knowledge about tools that support software testing • gain knowledge about the principles of test management	**Workload:** Attendance time: 42 h Self-study time: 108 h

Course: Software Testing (Lecture, Exercise)	3 WLH
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** Develop and present the solution of at least one exercise (presentation and report) and active participation in the exercises. **Examination requirements:** The students have to show knowledge in software quality, principles of software quality assurance, general test process, static analysis, dynamic analysis, black-box testing, glass-box testing, testing of object-oriented systems, testing tools, and test management.	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1153: Specialization Softwareengineering: Requirements Engineering**	5 C 3 WLH
Learning outcome, core skills: The students • can define the terms requirement and requirements engineering and acquire knowledge on the principles of requirements engineering • become acquainted with the general requirements engineering process and know how it can be embedded into the overall software development process • gain knowledge about the system context and context boundaries • gain knowledge about requirements elicitation techniques and the interpretation of elicitation results • gain knowledge about the negotiation of requirements with different stakeholders • gain knowledge about the structure of documents for the requirements documentation • gain knowledge about the requirements documentation in natural language and techniques for the use of structured natural language • gain knowledge about the requirements documentation with models and model-based techniques for requirements documentation • gain knowledge about the validation of requirements • gain knowledge about managing changes to requirements • gain knowledge about tracing requirements through a development process	**Workload:** Attendance time: 42 h Self-study time: 108 h
Course: Requirements Engineering (Lecture, Exercise)	3 WLH
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** Develop and present the solution of at least one excercise (presentation and report) and active participation in the exercise sessions. **Examination requirements:** Requirements, requirements engineering, general requirements engineering process, system context, system boundary, context boundary, requirements elicitation and interpretation, requirements negotiation, structure of requirements documentation, requirements documentation in natural language, model-based requirements documentation, requirements validation, requirements change management, requirements tracing.	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1154: Specialization Softwareengineering: Software Evolution**	5 C 3 WLH
Learning outcome, core skills: The students • can define the term software evolution and acquire knowledge on the principles of software evolution and maintenance • become acquainted with general approaches for mining software repositories to understand, predict, and control the evolution of software • gain knowledge about typical data and data sources used in software evolution studies • gain knowledge about mining methods and tools for modeling, obtaining, and integrating data from software projects, including mining version control system data, mining issue tracking system data, mining static analysis data, mining clone detection data • gain knowledge about labelling and classification of artifacts and activities in software projects • gain knowledge about prediction, simulation, visualization, and other applications built upon mined software evolution data	**Workload:** Attendance time: 42 h Self-study time: 108 h
Course: Software Evolution (Lecture, Exercise)	3 WLH
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** Develop and present the solution of at least one exercise (presentation and report), active participation in the exercise sessions. **Examination requirements:** The students shall prove knowledge in the area of software evolution. This includes knowledge regarding principles of software evolution, software maintenance, software quality, mining software repositories, data mining, defect prediction, software clones, static analysis, dynamic analysis and human factors in software evolution.	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1155: Seminar: Advanced Topics in Software Engineering**	5 C 2 WLH
Learning outcome, core skills: The students • learn to become acquainted with an advanced topic in software engineering by studying up-to-date research papers. • gain knowledge about advanced topics in software engineering. The advanced topic may be related to areas such as software development processes, software quality assurance, and software evolution. • learn to present and discuss up-to-date research on advanced topics in software engineering. • learn to assess up-to-date research on advanced topics in software engineering.	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Seminar on Advanced Topics in Software-Engineering (Seminar) *Contents*: Topics which will be covered by this seminar can include • Usability and Usability-Engineering • User-oriented Usability Testing • Expert-oriented Usability Evaluation • Web-analytics • Information Architecture • SOA – Service-oriented Architecture • UML-Tools and Code Generation • Details of Specific Process Models • Model-driven Architecture • Usage-based Testing • Defect Prediction • Design Patterns • Agent-based Simulation • Reliability-Engineering for Cloud Systems	2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) **Examination prerequisites:** Attendance in 80% of the seminar presentations **Examination requirements:** The students shall show that • they are able to become acquainted with an advanced topic in software engineering by investigating up-to-date research publications. • they are able to present up-to-date research on an advanced topic in software engineering. • they are able to assess up-to-date research on an advanced topic in software engineering.	5 C

• they are able to write a scientific report on an advanced topic in software engineering according to good scientific practice. Presentation of an advanced topic in software engineering and written report.	

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1171: Service-Oriented Infrastructures**	5 C 3 WLH

Learning outcome, core skills:	**Workload:**
Successfully completing the module, students • understand basic web technologies (transfer protocols, markup languages, markup processing, RESTful and SOAP web services) • understand virtualisation technologies (server, storage, and network virtualisation) • understand Cloud computing (standards, APIs, management, service layers) • understand security mechanisms for distributed systems (authentication, authorisation, certificates, public key infrastructures) • understand data services (sharing, management, and analysis) • understand Big Data technology (MapReduce) On completion of this module students will have a good understanding of the fundamental and up-to-date concepts used in the context of service-oriented infrastructures. This basic knowledge can be leveraged by students to design, implement, and manage service-oriented infrastructures by themselves.	Attendance time: 42 h Self-study time: 108 h

Course: Service Computing (Lecture, Exercise)	3 WLH
Contents: Service-oriented infrastructures are the backbone of modern IT systems. They pool resources, enable collaboration between people, and provide complex services to end-users. Everybody who uses today's web applications such as Facebook, Google, or Amazon implicitly relies on sophisticated service-oriented infrastructures. The same is true for users of mobile devices such as tablet computers and smart phones, which provide most of their benefits leveraging services such as Dropbox, Evernote, and iTunes. These examples and many more services build on sophisticated service-oriented infrastructures. The key challenges of service-oriented infrastructures are related to scaling services. More specifically large service-oriented infrastructures require scalability of IT management, programming models, and power consumption. The challenges to scale services lie in the inherent complexity of hardware, software, and the large amount of user requests, which large-scale services are expected to handle. This module teaches methods that address and solve those challenges in practice. Key aspects of the module are the management of IT infrastructures, the management of service landscapes, and programming models for distributed applications. IT management covers Cloud computing, and the virtualisation of computing, storage, and network resources. Cloud computing in specific is covered by the discussion of production-grade infrastructure-as-service and platform-as-a-service middlewares. IT management is covered by the discussion of deployment models, service level agreements, and security aspects. Programming models are covered by discussing RESTful and SOAP web-services, MapReduce, and OSGi. Both, lectures and exercises, keep a close connection to the practical application of the discussed topics. The practical value of service-oriented infrastructures is highlighted in the context of enterprises as well as in the context of science. The methods taught	

in this module benefit from the lecturers' experiences at GWDG and thus provide exclusive insights into the topic. After successfully attending these modules students will understand the most important aspects to design, implement, and manage internet-scale service-oriented infrastructures.	
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination requirements:** • RESTful and SOAP web services • XML • Compute, storage, and network virtualisation • Infrastructure-as-a-service, platform-as-a-service, software-as-a-service • Characteristics of Cloud computing (NIST) • OSGi • MapReduce • iRODS • Service level agreements • Symmetric and asymmetric encryption (SSL, TLS) • Security certificates (X.509) • Public key infrastructures	5 C

Admission requirements: none	**Recommended previous knowledge:** • Programming basics in Java or a similar language • Basic understanding of operating systems and command line interfaces
Language: English	**Person responsible for module:** Prof. Dr. Ramin Yahyapour
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1172: Using Research Infrastructures**	5 C 3 WLH

Learning outcome, core skills: Successfully completing the module, students • understand what methods and services are available in state-of-the-art research infrastructures and direction of future development • understand the infrastructures for eScience and eResearch • know basics of data management and data analysis • know the fundamental of technologies like cloud computing and grids • understand the real-world problems from different domains (e.g., high energy physics, humanities, medical science, etc.) which are tackled by research infrastructures • understand certain aspects, methods and tools of these infrastructures for different use cases from different domains • will be motivated to take part in other related modules (e.g., Specialization in Distributed Systems, Parallel Computing, etc.)	**Workload:** Attendance time: 42 h Self-study time: 108 h

Course: Using Research Infrastructures - Examples from Humanities and Sciences (Lecture, Exercise) *Contents*: Successfully completing the lecture, students • understand the role and importance of the research infrastructure and their general building blocks • know the basics of grid computing • know the basics of cloud computing • learn basics on system virtualization • learn fundamental ideas of data management and analysis • understand the real-world problems from different domains (e.g., high energy physics, humanities, medical science/life science, etc.) which are tackled by research infrastructures • understand certain aspects, methods and tools of these infrastructures for different use cases from different domains • will be motivated to take part in other related modules (e.g., Specialization in Distributed Systems, Parallel Computing, etc.) • get familiar with real-world challenges through talks from experts who will present their current research activities and the role of research infrastructures on their research	3 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Grid computing; cloud computing; system virtualization; data management; data analysis; application of eResearch infrastructure in high energy physics; eResearch in medicine and life science; eResearch in humanities	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ramin Yahyapour
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1185: Sensor Data Fusion**	5 C 3 WLH

Learning outcome, core skills: This module is concerned with fundamental principles and algorithms for the processing and fusion of noisy (sensor) data. Applications in the context of navigation, object tracking, sensor networks, robotics, Internet-of-Things, and data science are discussed. After successful completion of the module, students are able to • define the notion of data fusion and distinguish different data fusion levels • explain the fundamentals of dynamic state estimation (including the Kalman filter) • formalize data fusion problems as state estimation problems • describe and model the most relevant sensors • define the most common discrete-time and continuous-time dynamic models • perform a time-discretization of continuous-time models • apply the Kalman filter to linear state estimation problems • explain and apply basic nonlinear estimation techniques such as the Extended Kalman filter (EKF) • assess the properties, advantages, and disadvantages of the discussed (nonlinear) estimators • deal with unknown correlations in data fusion • implement, simulate, and analyze data fusion problems in MATLAB • describe and implement basic algorithms for simultaneous localization and mapping (SLAM) in MATLAB • identify data fusion applications and assess the benefits of data fusion	**Workload:** Attendance time: 42 h Self-study time: 108 h

Course: Sensor Data Fusion (Lecture, Exercise)	3 WLH
Examination: Written exam (90 min.) or oral exam (approx. 20 min.) **Examination prerequisites:** Presentation of at least one exercise and active participation during the exercises. **Examination requirements:** Definition of data fusion; fundamentals of dynamic state estimation (including the Kalman filter); formalization of data fusion problems; typical sensor models; typical discrete-time and continuous-time dynamic models; discretization of continuous-time models; Extended Kalman filter (EKF); algorithms for dealing with unknown correlations in data fusion; basic algorithms for simultaneous localization and mapping (SLAM)	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marcus Baum
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1186: Seminar Hot Topics in Data Fusion and Analytics**	5 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students are able to • get acquainted with a specific research topic in the area of data fusion and data analytics • explain the considered problem in the chosen research topic • collect, evaluate, and summarize related work • describe solution approaches for the considered problem • discuss advantages and disadvantages of the proposed approaches • give an outlook to future research directions • prepare and give a presentation about the chosen research topic • write a scientific report about the chosen research topic • follow recent research in data fusion and data analytics	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Hot Topics in Data Fusion and Analytics (Seminar)	2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) **Examination prerequisites:** Attendance in 80% of the seminar presentations **Examination requirements:** Advanced knowledge of a specific research topic in the field of data fusion and data analytics; written scientific report; oral presentation	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marcus Baum
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1187: Simulation-based Data Fusion and Analysis**	5 C 3 WLH

Learning outcome, core skills: This module introduces fundamental simulation-based algorithms for the Bayesian fusion and analysis of noisy data sets. After completion, the students are able to • describe the Bayesian approach to data fusion and analysis • set up probabilistic state space models for time series data • describe the concept of a recursive Bayesian state estimator • employ Monte Carlo simulation for Bayesian inference • explain and apply sequential Monte Carlo methods, i.e., particle filters, such as Sequential Importance Sampling (SIS) and Sequential Importance Resampling (SIR) • explain and apply Markov Chain Monte Carlo (MCMC) methods such as Metropolis-Hasting and Gibbs sampling • describe the Bayesian interpretation of the Kalman filter • apply simulation-based implementations of the Kalman filter such as the Unscented Kalman Filter (UKF) and the Ensemble Kalman filter (EnKF) • employ Monte Carlo simulation for inference in probabilistic graphical models • explain Rao-Blackwellization and apply it to Simultaneous Localization and Mapping (SLAM) • assess the properties, advantages, and disadvantages of simulation-based techniques • apply the above concepts in the context of machine learning, computer vision, robotics, object tracking, and data science	**Workload:** Attendance time: 42 h Self-study time: 108 h

Course: Simulation-based Data Fusion and Analysis (Lecture, Exercise)	3 WLH
Examination: Written exam (90 min.) or oral exam (approx. 20 min.) **Examination prerequisites:** Presentation of at least one exercise and active participation during the exercises. **Examination requirements:** Probabilistic state space models for time series data; recursive Bayesian state estimator; Monte Carlo simulation; Sequential Monte Carlo methods (particle filters); Sequential Importance Sampling (SIS) and Sequential Importance Resampling (SIR); Markov Chain Monte Carlo (MCMC) methods such as Metropolis-Hasting and Gibbs sampling; simulation-based implementations of the Kalman filter; Application of Monte Carlo simulation for inference in probabilistic graphical models; Rao-Blackwellization.	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marcus Baum
Course frequency: irregular	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1222: Specialization Computer Networks**	5 C 2 WLH
Learning outcome, core skills: The students • have gained a deeper knowledge in specific topics within the computer networks field • have improved their oral presentation skills • know how to methodically read and analyse scientific research papers • know how to write an analysis of a specific research field based on their analysis of state-of-the-art research • have improved their ability to work independently in a pre-defined context	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Advanced Topics in Computer Networks (Seminar)	2 WLH
Examination: Präsentation (ca. 30 min.) und Hausarbeit (max. 15 Seiten) **Examination requirements:** Knowledge in a specific field of advanced computer networks technology; ability to present the earned knowledge in a proper way both orally and in a written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unrregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1223: Advanced Topics in Computer Networks**	5 C 2 WLH

Learning outcome, core skills: The students • know the principles of existing and emerging advanced networking technologies • know the details of Peer-to-Peer networks • are capable to describe the principles of cloud computing • have a basic understanding of information centric networking • are able to analyze social networks • have been introduced to state-of-the-art research in the computer networks field	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Advanced Computer Networks (Lecture)	2 WLH
Examination: Mündliche Prüfung (ca. 30 min.) oder Klausur (90 Minuten) **Examination requirements:** advanced networking technologies, Peer-to-Peer networks, cloud computing, information centric networking, social networks, state-of-the-art research in the computer networks field	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures; basic programming skills
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 100	

Georg-August-Universität Göttingen **Module M.Inf.1226: Security and Cooperation in Wireless Networks**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
On completion of the module students should be able to: • recall cryptographic algorithms and protocols such as encryption, hash functions, message authentication codes, digital signatures and session key establishment • explain security requirements and vulnerabilities of existing wireless networks • discuss upcoming wireless networks and new security challenges that are arising • name trust assumptions and adversary models in the era of ubiquitous computing • show how naming and addressing schemes will be used in the future of the Internet and how these schemes can be protected against attacks • explain how security associations can be established via key establishment, exploiting physical contact, mobility, properties of vicinity and radio link • define secure neighbour discovery and explain the wormhole attack and its detection mechanisms • describe secure routing in multi-hop wireless networks by explaining existing routing protocols, attacks on them and the security mechanisms that can help to achieve secure routing • discuss how privacy protection can be achieved in MANETs in several contexts, such as location privacy and privacy in routing, and recall privacy related notions and metrics • recall selfish and malicious node behaviour on the MAC layer CSMA/CA, in packet forwarding and the impact on wireless operators and the shared spectrum; as countermeasure secure protocols for behaviour enforcement should be known • differentiate between different game theory strategies that can be used in wireless networks	Attendance time: 56 h Self-study time: 124 h

Course: Security and Cooperation in Wireless Networks (Lecture, Exercise)	4 WLH
Examination: Written exam (90 min.) or oral exam (approx. 20 min.) **Examination requirements:** Cryptographic algorithms and protocols, hash functions, message authentication codes, digital signatures, session keys; security requirements, challenges and vulnerabilities in wireless networks; trust assumptions and adversary models in ubiquitous computing; naming and addressing schemes in the future internet; establishment of secure associations (key establishment, exploiting physical contact, mobility, properties of vicinity and radio link); secure neighbourhood discovery and wormhole attack detection mechanisms; secure routing in multi-hop wireless networks; privacy protection in MANETs (location privacy, routing privacy); enforcement of cooperative behaviour in MANETs; game theory strategies used in wireless networks	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in telematics and computer networks
Language:	**Person responsible for module:**

English	Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1227: Machine Learning for Computer Security**	6 C 4 WLH

Learning outcome, core skills: After successful completion of the modul students are able to • differentiate different types of learning methods • analyse and design feature spaces for security problems • create kernel functions for security problems • explain learning methods for classification and anomaly detection • apply and compare learning methods for network intrusion detection • explain learning methods for clustering • apply and compare learning methods for malware analysis • describe signature generation and evasion attacks • explain learning methods for dimension reduction • apply and compare learning methods for vulnerability discovery	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Machine Learning for Computer Security (Lecture, Exercise)	4 WLH
Examination: Klausur (120 min.) oder mündliche Prüfung (ca. 20 Min.) **Examination prerequisites:** successful completion of 50 % of the exercises **Examination requirements:** Feature spaces and kernel functions; anomaly detection and classification for intrusion detection; clustering of malicious software; signature generation; evasion attacks; dimension reduction and vulnerability discovery	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konrad Rieck
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1228: Seminar Recent Advances in Computer Security**	5 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students are able to • explain current problems of computer security • summarize and present an approach addressing current problems • discuss theoretical and practical details of the approach • identify and review related work • analyse advantages and shortcomings of related approaches • propose possible solutions and extensions	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Hot Topics in Computer Security (Seminar)	2 WLH
Examination: Vortrag (ca. 30 min.) mit schriftlicher Ausarbeitung (max. 10 Seiten) **Examination requirements:** Current problems of security; detailed discussion of one solution; comparison with related work; written report; oral presentation	5 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konrad Rieck
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1229: Seminar on Specialization in Telematics**	5 C 2 WLH
Learning outcome, core skills: On completion of the module students should be able to: • critically investigate current research topics from the area of telematics such as bio-inspired approaches in the area of wireless communication or security attacks and countermeasures for mobile wireless networks • collect, evaluate related work and reference them correctly • summarize the findings in a written report • prepare a scientific presentation of the chosen research topic	**Workload:** Attendance time: 28 h Self-study time: 122 h

Courses:	
1. Network Security and Privacy (Seminar)	2 WLH
2. Security of Self-organizing Networks (Seminar)	2 WLH
3. Trust and Reputation Systems (Seminar)	2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) **Examination requirements:** The students shall show that • they are able to become acquainted with a specialized topic in telematics by investigating up-to-date research publications • they are able to present up-to-date research on a specialized topic in telematics • they are able to assess up-to-date research on a specialized topic in telematics • they are able to write a scientific report on a specialized topic in telematics according to good scientific practice	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in telematics and computer networks
Language: English	**Person responsible for module:** Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.Inf.1230: Specialization Software-defined Networks (SDN)	5 C 2 WLH

Learning outcome, core skills: The students • are familiar with advanced concepts of software defined networking (SDN) • know how to methodically read, analyse and discuss scientific research papers • have enriched their practical skills in computer networks with regards to SDN and its applications • know about practical deployability issues of SDN • have improved their ability to work independently in a pre-defined context • have improved their ability to work in diverse teams	**Workload:** Attendance time: 28 h Self-study time: 122 h

Course: Specialization in Software-defined Networking (Exercise, Seminar)	2 WLH
Examination: Term Paper (max. 20 pages) **Examination prerequisites:** Erreichen von mindestes 50% der Übungspunkte **Examination requirements:** Advanced knowledge in software-defined networking; ability to transfer the theoretical knowledge to practical exercises; ability to present the earned knowledge in a proper written report	5 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures; advanced programming skills
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1231: Specialization in Distributed Systems**	6 C 4 WLH
Learning outcome, core skills: Successfully completing the module, students • have in-depth knowledge about one specific topical area of distributed systems • understand the challenges of designing this specific part of a distributed system and integrating it into a larger infrastructure • understand the tasks to operate this specific part of a distributed system within a modern data centre • can apply their knowledge to evaluate application scenarios and make decisions regarding the applicability of certain technical solutions Examples for specific topics are distributed architectures or distributed data and information management.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Distributed Storage and Information Management (Lecture, Exercise) *Contents*: Successfully completing the module, students • understand how data and information can be stored and managed • know the generic components of a modern data centre • understand how to protect data using RAID and what RAID level to apply to what problem • know about “intelligent” storage systems, including concepts like caching • understand various storage networking technologies like Fibre Channel, iSCSI, and FCoE • know about network-attached, object and unified storage • basically understand how to achieve business continuity of storage systems • understand the different backup and archiving technologies • understand data replication • have a basic understanding of storage virtualization • know how to manage and how to secure storage infrastructures Remark With this lecture, we provide a preparation for the exam for the EMC Information Storage and Management Certificate. The Institute of Computer Science of the University of Göttingen is a Proven Professional of the EMC Academic Alliance. References S. Gnanasundaram, A. Shrivastava (eds.), Information Storage and Management, John Wiley & Sons, 2012. ISBN:978-1-118-09483-9	4 WLH
Examination: Written exam (90 min.) or oral exam (ca. 20 min.) **Examination prerequisites:** Solving and presenting at least one exercise (written solution and presentation), as well as active participation during the exercises.	6 C

Examination requirements: Information Storage; Data Centre Environment and Components; RAID; Caching; Storage Provisioning; Fibre Channel; IP SAN; FCoE; Network-Attached Storage; Object-Based and Unified Storage; Backup and Archiving; Replication; Storage Cloud; Security in Storage Infrastructures; Management of Storage Infrastructures	

Admission requirements: none	**Recommended previous knowledge:** • Computer architecture • Basic network protocols • Virtualisation techniques
Language: English	**Person responsible for module:** Prof. Dr. Ramin Yahyapour (Dr. Philipp Wieder)
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1232: Parallel Computing**	6 C 4 WLH
Learning outcome, core skills: Successfully completing the module, students are able to: • define and describe the benefit of parallel computing • specify the classification of parallel computers (Flyn classification) • analytically evaluate the performance of parallel computing approaches (scaling/ performance models) • know the parallel hardware and performance improvement approaches (cache coherence, pipeline, etc.) • know the interconnects and networks and their role in parallel computing • understand and develop sample parallel programs using different paradigms and development environments (e.g., shared memory and distributed models) • expose to some applications of Parallel Computing through hands-on exercises	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Parallel Computing (Lecture, Exercise) *Contents*: Successfully completing the lecture, students are able to: • define and describe the benefit of parallel computing and identify the role of software and hardware in parallel computing • specify the Flynn classification of parallel computers (SISD, SIMD, MIMD) • analytically evaluate the performance of parallel computing approaches (Scaling/ Performance models) • understand the different architecture of parallel hardware and performance improvement approaches (e.g., caching and cache coherence issues, pipeline, etc.) • define Interconnects and networks for parallel computing • architecture of parallel computing (MPP, Vector, Shared memory, GPU, Many-Core, Clusters, Grid, Cloud) • design and develop parallel software using a systematic approach • parallel computing algorithms and development environments (i.e. shared memory and distributed memory parallel programming) • write parallel algorithms/programs using different paradigms and environments (e.g., POSIX Multi-threaded programming, OpenMP, MPI, OpenCL/CUDA, MapReduce, etc.) • get exposed to some applications of Parallel Computing through exercises References • An Introduction to Parallel Programming, Peter S. Pacheco, Morgan Kaufmann (MK), 2011, ISBN: 978-0-12-374260-5. • Designing and Building Parallel Programs, Ian Foster, Addison-Waesley, 1995, ISBN 0-201-57594-9 (Available online).	4 WLH

• Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, Int. Edition, McGraw Hill, 1993, ISBN: 0-07-113342-9. • In addition to the mentioned text book, tutorial and survey papers will be distributed in some lectures as extra reading material.	
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) **Examination requirements:** Parallel programming; Shared Memory Parallelism; Distributed Memory Parallelism, Single Instruction Multiple Data (SIMD); Multiple Instruction Multiple Data (MIMD); Hypercube; Parallel interconnects and networks; Pipelining; Cache Coherence; Parallel Architectures; Parallel Algorithms; OpenMP; MPI; Multi-Threading (pthreads); Heterogeneous Parallelism (GPGPU, OpenCL/CUDA)	6 C

Admission requirements: • Data structures and algorithms • Programming in C/C++	**Recommended previous knowledge:** • Computer architecture • Basic knowledge of computer networks and topologies
Language: English	**Person responsible for module:** Prof. Dr. Ramin Yahyapour
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen Module M.Inf.1250: Seminar: Software Quality Assurance	5 C 2 WLH
Learning outcome, core skills: The students • learn to become acquainted with an advanced topic in software quality assurance by studying up-to-date research papers • gain knowledge about advanced topics in software quality assurance. The advanced topic may be related to areas such as test processes, software metrics, black-box testing,white-box testing, test automation, test generation and testing languages • learn to present and discuss up-to-date research on advanced topics in software quality assurance. • learn to assess up-to-date research on advanced topics in software quality assurance	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Randomness and Software Testing (Seminar) *Contents*: Since exhaustive testing of software is almost never possible, different approaches towards the determination of appropriate test suites have been proposed throughout the years. One direction is to randomize the generation of software tests. This does not necessarily mean that there is no underlying strategy, the opposite is the case. The inputs and/or execution paths of software are created using probability distributions with the aim to optimize certain quality aspects of software. This seminar addresses topics from randomized software testing, including randomized selection of execution paths (e.g., through usage-based testing) and randomized generation of test data (e.g., using fuzzing). In addition to the techniques themselves, we also address how randomized approaches differ from traditional approaches based on coverage criteria and/or heuristics.	2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) **Examination prerequisites:** Attendance in 80% of the seminar presentations **Examination requirements:** The students shall show that • they are able to become acquainted with an advanced topic in software quality assurance by investigating up-to-date research publications • they are able to present up-to-date research on an advanced topic in software quality assurance • they are able to assess up-to-date research on an advanced topic in software quality assurance • they are able to write a scientific report on an advanced topic in software quality asssurance according to good scientific practice Presentation of an advanced topic in software engineering and written report.	5 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1251: Seminar: Software Evolution**	5 C 2 WLH
Learning outcome, core skills: The students • learn to become acquainted with an advanced topic in software evolution by studying up-to-date research papers • gain knowledge about advanced topics in software evolution. The advanced topic may be related to areas such as comparison of software projects, defect analysis and prediction, version control and infrastructure, changes and clones, impact analysis, practical applications and experiments, patterns and models, as well as integration and collaboration (process-related and social aspects) • learn to present and discuss up-to-date research on advanced topics in software evolution • learn to assess up-to-date research on advanced topics in software evolution	**Workload:** Attendance time: 28 h Self-study time: 122 h
Course: Mining Software Repositories (Seminar) *Contents*: The topics in this seminar on software evolution will include the following areas: • comparison of projects • defect analysis and prediction • version control and infrastructure • beyond source code - text analysis • search and recommendation • changes and clones • impact analysis • practical applications and experiments • available resources • visualization and presentation of results • patterns and models • integration and collaboration (process-related and social aspects)	2 WLH
Examination: Presentation (approx.45 minutes) and written report (max. 20 pages) **Examination prerequisites:** Attendance in 80% of the seminar presentations **Examination requirements:** The students shall show that • they are able to become acquainted with an advanced topic in software evolution by investigating up-to-date research publications • they are able to present up-to-date research on an advanced topic in software evolution • they are able to assess up-to-date research on an advanced topic in software evolution • they are able to write a scientific report on an advanced topic in software evolution according to good scientific practice	5 C

Presentation of an advanced topic in software engineering (approx.45 minutes) and written seminar report (max. 20 pages)	

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1281: NOSQL Databases**	6 C 4 WLH
Learning outcome, core skills: Learning how to store arbitrary documents, objects of programming languages, XML data and graphs in native databases; and comparison to storing these data in relational databases. Getting to know novel requirements for database management systems like flexible update and query behavior and distributed data on multiple servers.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: NOSQL Databases (Lecture, Exercise) *Contents*: The lecture covers for example graph databases, object databases , XML databases, key-value stores, and column-based databases, as well as concepts of distributed data management.	4 WLH
Examination: Klausur (90 Minuten) oder mündliche Prüfung (ca. 25 Minuten) **Examination requirements:** Presenting concepts, data models and storage mechanisms of the different NOSQL databases; explaining differences to the relational model. Showing basic knowledge of NOSQL query languages and access models. Explaining concepts of distributed database systems.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Dr. Lena Wiese
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Inf.1800: Practical Course Advanced Networking**	6 C 4 WLH
Learning outcome, core skills: The students • know the principles of one existing or emerging advanced networking technology • are able to implement these technologies in useful mobile applications • ideally have advanced in their researching ability • have improved their programming skills • have improved their oral presentation skills • have improved their scientific writing skills • have improved their teamwork	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Practical Course Advanced Networking Lab (Internship)	4 WLH
Examination: Präsentation (ca. 30 min.) und Hausarbeit (max. 15 Seiten) **Examination requirements:** advanced networking technology, mobile applications, programming, oral presentation, scientific writing, teamwork	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in computer networks; basics of algorithms and data structures; basic programming skills
Language: English	**Person responsible for module:** Prof. Dr. Xiaoming Fu
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Inf.1803: Practical Course in Software Engineering**	6 C 4 WLH

Learning outcome, core skills: The students • learn to become acquainted with up-to-date methods and software tools • learn to select methods and tools for given practical problems in software engineering • learn to apply methods and tools for given practical problems in software engineering • learn to assess methods and tools for given practical problems in software engineering by performing experiments	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Practical Course on Parallel Computing (Internship) *Contents*: This practical course includes practical exercises on: Distributed memory architectures • Cluster computing with Torque PBS • Grid Computing with Globus Toolkit • Message Passing Interface (MPI) • MapReduce Shared Memory architectures • OpenMP • Pthreads Heterogeneous parallelism (GPU, CUDA, etc.) • CUDA	4 WLH
Examination: Practical exercises in small groups (approx. 4-12 exercises) and oral examinations for the exercises (approx. 15 minutes each), not graded **Examination prerequisites:** Attendance in 90% of the classes **Examination requirements:** The students shall show that • they are able to become acquainted with up-to-date methods and software tools • they are able to select methods and tools for given practical problems in software engineering • they are able to apply methods and tools for given practical problems in software engineering • they are able to assess methods and tools for given practical problems by performing experiments	6 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.

Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Inf.1804: Practical Course in Software Quality Assurance**	6 C 4 WLH
Learning outcome, core skills: The students • learn to become acquainted with up-to-date methods and software tools for software quality assurance • learn to select methods and tools for given practical problems in software quality assurance • learn to apply methods and tools for given practical problems in software quality assurance • learn to assess methods and tools for given practical problems in software quality assurance by performing experiments	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Practical Course on Software Evolution: Origin Analysis (Internship) *Contents*: Changes in the usage requirements and the technological landscape, among others, drive a continuous necessity for changes in software systems in order to sustain their existence and operability in changing environments. Origin analysis aims to determine the location of points of interest through time. For example, origin analysis aids on the one hand projecting the location of past changes into the current state of the code base, and on the other hand determining previous locations and origins of detected issues. In this course, we will build and extend an existing infrastructure for performing origin analysis and use it to perform studies on large software systems, such as Google Chrome, Mozilla Firefox, Amarok, and others.	4 WLH
Examination: Practical exercises in small groups (approx. 4-6 exercises) and oral examinations for the exercises (approx. 15 minutes each), not graded **Examination prerequisites:** Attendance in 90% of the classes **Examination requirements:** The students shall show that • they are able to become acquainted with with up-to-date methods and software tools for software quality assurance • they are able to select methods and tools for given practical problems in software quality assurance • they are able to to apply methods and tools for given practical problems in software quality assurance • they are able to to assess methods and tools for given practical problems in software quality assurance by performing experiments	6 C

Admission requirements: none	**Recommended previous knowledge:** Foundations of software engineering.
Language: English	**Person responsible for module:** Prof. Dr. Jens Grabowski

Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Module M.Inf.1808: Practical Course on Parallel Computing	6 C 4 WLH
Learning outcome, core skills: Successfully completing the module, students are able to: • practically work with a cluster of computers (e.g., using a batch system) • practically utilize grid computing infrastructures and manage their jobs (e.g., Globus toolkit) • apply distributed memory architectures for parallelism through practical problem solving (MPI programming) • utilize shared memory architectures for parallelism (e.g., OpenMP and pthreads) • utilize heterogenous parallelism (e.g., OpenCL, CUDA and general GPU programming concepts) • utilize their previous knowledge in data structures and algorithms to solve problems using their devised (or enhanced) parallel algorithms	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Practical Course on Parallel Computing (Internship) *Contents*: As a practical course, the focus will be on the hands-on session and problem solving. Students will get a brief introduction to the topic and then will use the laboratory equipment to solve assignments of each section of the course.	4 WLH
Examination: Oral examination (approx. 20 minutes), not graded **Examination requirements:** • understand how to manage computing jobs using a cluster of computers or using grid computing facilities • understand the configuration of a PBS cluster through practical assignments • practically use LRM clusters and POVRay examples • understand cluster computing related topics (error handling, performance management, security) in more depth and using hands-on experience and practically using Globus toolkit • design and implement solutions for parallel programs using distributed memory architectures (using MPI) • design and implement solutions for parallel programs using shared memory parallelism (using OpenMP, pthreads) • practically work with MapReduce programming framework and problem solving using MapReduce • practically work with heterogenous parallelism environment (GPGPU, OpenCL, CUDA, etc.)	6 C

Admission requirements:	**Recommended previous knowledge:**
• Data structures and algorithms • Programming in C(/C++)	• Parallel Computing • Computer architecture • Basic knowledge of computer networks • Basic know-how of computing clusters

Language: English	**Person responsible for module:** Prof. Dr. Ramin Yahyapour
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Inf.1820: Practical Course on Wireless Sensor Networks	6 C 4 WLH
Learning outcome, core skills: On completion of the module students should be able to: • name the special characteristics of operating systems for wireless sensor networks with a special focus on TinyOS • develop applications for real hardware sensor nodes such as IRIS motes and Advanticsys motes • gather data using the hardware sensor nodes • conduct software-based simulations using the TOSSIM framework for testing and debugging TinyOS applications • implement applications that are able to collect, disseminate and process sensor data in WSNs • make use of over the air programming using Deluge to deploy new sensor applications without connecting over a wire to a stationary computer • apply encryption to the communication between the wireless motes • design, plan, implement and test a final research project considering an individual WSN application e.g. detection of audio signals, visualization of sensed data or integration of WSNs with the cloud	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Practical Course on Wireless Sensor Networks (Internship)	4 WLH
Examination: Written report (max. 15 pages) and presentation (approx. 25 min.) **Examination requirements:** special characteristics of operating systems for WSNs (TinyOS); application development for real hardware sensor nodes (IRIS motes, Advanticsys motes); data gathering using hardware motes; software-based simulations and debugging of TinyOS applications with TOSSIM; implementation of applications that collect, disseminate and process sensor data in WSNs; over the air programming of wireless motes (Deluge); encryption of communication in WSNs; design, planning, implementation and testing of individual application (final research project)	6 C

Admission requirements: Basic knowledge in telematics and computer networks	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Dieter Hogrefe
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Inf.1904: From written manuscripts to big humanities data**	6 C 4 WLH

Learning outcome, core skills: This course is designed for both students of Computer Science and of the Humanities. By working in groups of up to four people and solving problems as a team, students are involved in the entire process of transforming assets of our cultural heritage into digital data (Digital Transformation). The students will work in particular with the transcriptions of manuscripts, by analysing digitally available texts with text mining and information retrieval techniques. Students will also gain knowledge and experience with the problems that arise because of information overload and information poverty. If on the one hand digitisation leads to an 'information overload' of digitally available data, on the other, the 'information poverty' embodied by the loss of books and the fragmentary state of texts form an incomplete and biased view of our past. Students will understand that in a digital ecosystem this coexistence of data overload and poverty adds considerable complexity to scholarly research. Students will, therefore, learn how to deal with uncertain data.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. The letters and tales of the brothers Grimm (Seminar) *Contents*: This course specialises on handwritten texts by the brothers Grimm. *Course frequency:* irregular	2 WLH
2. Cultural Heritage Programming (Practical course) *Contents*: The object of this course is for students to develop and implement a team project related to historical data. Students will gain knowledge and experience in versioning and building systems, as well as managing a project and working with historical data, which is often fragmentary or hard to attribute to a specific author or line of transmission. The project that students will work on will depend on their programming skills. Students will be able to pick an area of interest, spanning from linguistic acquisition to visualisations of historical data, to the natural language processing of texts, OCR processing and handwriting recognition or infrastructural development. *Course frequency:* irregular	2 WLH
Examination: Seminar work of about 20 pages **Examination prerequisites:** Regular and active participation in the courses; students commit to a project and actively contribute. **Examination requirements:** With the examination students will prove their knowledge of the content, background and context history of the chosen text, as well as showing their capability of transcribing, processing and visualizing historical data. Students will also demonstrate whether they are able to work as part of a team on common problem solving activities.	6 C

The knowledge and skills of the student will be tested with written essays, wiki, blog entries, a position statement, or an written equivalent.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Marco Büchler
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.IntTheol.02: Christianity in an Intercultural Perspective**	7 C 4 WLH

Learning outcome, core skills: In this module, students acquire in-depth knowledge of: • important contextual theologies in overview, • transnationalisation, globalisation and development theories, • denominational studies and the history of the ecumenical movement, and the ability to: • appreciate contextual theologies critically and develop a personal stand, • use and develop concrete examples to present the possibilities and limitations of applying different theoretical approaches, and • analyse ecumenical discussions in a sensitive manner.	**Workload:** Attendance time: 56 h Self-study time: 154 h

Courses:	
1. The Ecumenical Movement (Lecture)	2 WLH
2. Contextual Theologies (Seminar)	2 WLH
Examination: Essay (max. 10 pages) **Examination prerequisites:** Regular attendance at 2. **Examination requirements:** • In-depth knowledge of structures and central positions of theological education. • Contextualisation of the Christian message in common social processes and its description in social scientific terms. • Sound knowledge and analytical skill in the areas of denominational studies and Ecumenics. • Application of elementarising and mediating methods.	7 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Fritz Heinrich Prof. Dr. Wilhelm Richebächer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.IntTheol.03: Cross-Culture I**	9 C 6 WLH
Learning outcome, core skills: In this module, students acquire in-depth knowledge of: • the theoretical and methodological bases of cultural studies and of its relevance for theological reflection sensitive to intercultural and interreligious matters, • strategies of planning a research project in intercultural theology thematically and methodlogically, • ethical problems typically arising out of intercultural encounters in research, which may be relevant to the students' own research projects. Students also acquire the ability to: • develop their own project ideas and research questions, • reflect on the processes of intercultural exchange and to employ communicative strategies in intercultural encounters, • include questions from the field cultural studies in the conception, conduction and evaluation of projects in intercultural theology, • develop strategies for solving conflicts and crises that may arise in the course of their research project, • present the draft of their research project, to revise it according to critical feedback, and to create a time-table for the project.	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses:	
1. Intercultural Hermeneutics (Lecture)	2 WLH
2. Intercultural Research and Competence (Seminar)	2 WLH
3. Carrying Out an Intercultural Research Project (Colloquium)	2 WLH
Examination: Oral (approx. 20 mins); or written (90 mins) **Examination prerequisites:** Regular attendance at courses 2 and 3; draft of research project (max. 10 pages) with an oral presentation of the intended project (approx. 15 minutes) **Examination requirements:** Identification of and reflection on processes of transcultural exchange, modes of communication and problem areas.	9 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Fritz Heinrich Prof. Dr. Ulrike Schröder
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students:	

20	

Georg-August-Universität Göttingen **Module M.IntTheol.08: Religions, Churches and Theology in India and the Near East**	8 C 4 WLH
Learning outcome, core skills: In this module, students acquire specialist knowledge of: • Hinduism, Buddhism, Islam and Judaism in Asia • structures of religious and church history in India and the Near East and • significant stages in the history of theological research about and in India and the Near East and the ability to: • analyse religious and church historical texts and situations and • apply the methods of theology in India and the Near East to concrete examples	**Workload:** Attendance time: 56 h Self-study time: 184 h
Courses: **1. Vorlesung "History of Religions and Church History in India and the Near East"** (Lecture)	2 WLH
2. Seminar "Religion, Politics and Society in India" (Seminar)	2 WLH
Examination: Term Paper, Paper (max. 15 pages) (max. 15 pages) **Examination prerequisites:** Regular attendance at 2.	8 C
Examination requirements: • Sound knowledge of the structures of religious and church history, also with regard to the Hindu, Buddhist, Islamic and Jewish context • Ability to analyse systematically the relationship between church and religion and state in Asia • Sound knowledge of the significant stages in the history of theological research about and in India and the Near East and in colonial and missionary history • In-depth knowledge and exemplary skills in central theological methods of theology in India and the Near East and in the development of religious and church historical sources and situations	

Admission requirements: M.IntTheol.01, M.IntTheol.02	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Alle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.IntTheol.08a: Religions, Churches and Theology in Asia and the Middle East**	8 C 4 WLH

Learning outcome, core skills: In this module, students acquire basic knowledge of: • structures of the history of religions and Christianity in Asia and the Near East, • selected religious communities in Asia (Islam, Hinduism, Buddhism etc.), and • significant stages in the history of research in theology and religious studies in and about Asia and the Near East. Students also acquire the ability to: • analyse texts and situations from church history and religious history, • discuss and apply concepts and methods of theology in Asia vis-à-vis concrete examples, and • reflect on the history of Asian religions and Christianity with international guest lecturers and in various perspectives.	**Workload:** Attendance time: 56 h Self-study time: 184 h

Courses:	
1. History of Religions and Church History in Asia and the Middle East (Lecture)	2 WLH
2. Religion, Politics and Society in Asia and the Middle East (Seminar)	2 WLH
Examination: Term Paper (max. 15 pages) **Examination prerequisites:** Regular attendance at 2. **Examination requirements:** • Sound knowledge of the structures of religious and church history, also regarding the contexts of Islam, Hinduism etc. in Asia. • Ability to analyse systematically the relationship between religions and society in Asia. • Sound knowledge of significant stages in the history of research in theology and religious studies about and in Asia and the Near East, esp. regarding colonial and mission history. • In-depth knowledge and essential skills in central theological methods and concepts of Christian theology in Asia and the Near East and in the analysis of sources and situations pertaining to religious and church history.	8 C

Admission requirements: M.IntTheol.01, M.IntTheol.02	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Dr. h. c. mult. Martin Tamcke
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.IntTheol.14-01: Theories of Religion**	6 C 2 WLH

Learning outcome, core skills: In this module, students acquire introductory and basic knowledge of: • the history and problems of the concept of religion, • well-established and current conceptualisations of religion, • the academic terminology and categorisations (e.g. "religion", "faith", "piety") in the disciplines related to the study of religion, and • the general methods and methodology of approaching the phenomenon "religion". They will be basically capable of: • a complex presentation and differentiated assessment of the topic area, • an identification of implicit and explicit theoretical conceptions and argumentation in the field of "religion" and • a reasoned classification into a theoretical structure, • an analytical, responsible and critical approach to the phenomena and forms of religious reality, • an interpretation of religious symbols and imagery from different methodical perspectives, • a differentiation and critical assessment of academic perspectives of religion, • a general overview of the specifics of different academic approaches – religious philosophy, phenomenology, sociology, psychology, etc., and in general of • in-depth and systematic information and communication skills with regard to religious phenomena.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Theories of Religion (Seminar)	2 WLH
Examination: Oral (approx. 20 mins); or written (90 mins) **Examination prerequisites:** Regular attendance at the seminar. **Examination requirements:** • Differentiated elucidation and discussion of the term "religion". • Analysis and interpretation of specific examples of the application of the concept of religion. • Definition, analysis and critical evaluation of relevant religious theories and methodical approaches to religious phenomena.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Fritz Heinrich
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.IntTheol.14-05: Ethical Expertise in the Horizon of Religion**	6 C 2 WLH

Learning outcome, core skills: Students acquire introductory and basic knowledge, for example, of: • historically and currently relevant ethical theories, • important ethical issues and conceptions, • specific ethical reasoning and terminology, • aspects of values education, • normative manifestations of religious understanding of the world (e.g. "revelation" as justification, "tradition" as argument), and • the importance and manifestation of ethical theory in the context of (world) religions. They will be basically capable of: • a complex presentation and differentiated assessment of the topic area, • a critical interpretation and evaluation of the ethical dimension of current social action and their positioning in an overall theoretical structure, • a technically-correct preparation of an ethical report on a selected topic, • a discursive presentation and argumentation of a developed ethical position, and in general of • ethical discernment in the context of academic methodology and further systematic and complex information and communication skills with regard to the topic area.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Ethical Expertise in the Horizon of Religion (Seminar)	2 WLH
Examination: Oral (approx. 20 mins); or written (90 mins) **Examination prerequisites:** Regular attendance at block seminar **Examination requirements:** Application of the methods involved in the "ethical report" on an exemplary ethical issue in the context of interreligious /intercultural encounter; critical explanation and discussion of the report.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Fritz Heinrich
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.MED.0001: Linear Models and their mathematical Foundations**	9 C 6 WLH
Learning outcome, core skills: **Contents** Tests for multiple samples, multivariate normal distribution, distribution of quadratic forms, linear regression models, ANOVA models, ordinary and generalized least squares estimators, formulation of hypotheses, F-test, confidence intervals for model parameters, singular models, factorial designs, asymptotic methods **The students learn to** - master the fundamental methods for data analysis in case of multiple samples, - conduct an analysis of variance using statistical software, - interpret the results.	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses:	
1. Lineare Modelle (Lecture)	4 WLH
2. Lineare Modelle (Exercise)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points **Examination requirements:** In the examination, the students show that for the given problem they can formulate an adequate linear model, estimate its parameters and test hypotheses using a statistical software package. Moreover, they can interpret the results and critically assess them. The examination consists (to the same extent) of both the Lectures and Exercises.	9 C

Admission requirements: none	**Recommended previous knowledge:** Mathematische Grundlagen der angewandten Statistik
Language: English	**Person responsible for module:** Prof. Dr. Tim Friede
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 30	

Additional notes and regulations:
The actual examination type will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.MED.0003: Event data analysis**	6 C 4 WLH

Learning outcome, core skills: **Inhalt:** Kaplan-Meier estimator of survival functions, confidence intervals for Kaplan-Meier curves, hypothesis tests comparing survival curves, Cox proportional hazards model, parametric alternatives to the Cox proportional hazards model, counting processes, diagnostic methods for proportional hazards, frailty models, multivariate survival models, models for recurrent events **Qualifikationsziele:** The students • learn about the foundations and general principles of event data analysis • get familiar with standard and more advanced methods for event data analysis • learn how to implement these methods in statistical software using appropriate numerical procedures.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Ereigniszeitanalyse (Lecture)	2 WLH
2. Ereigniszeitanalyse (Exercise)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points **Examination requirements:** The students demonstrate their general understanding of statistical models and data analysis techniques for event data analysis. For a given problem they can critically assess the advantages and disadvantages of various models. Furthermore, they can fit an appropriate model using statistical software and interpret the results correctly for a given problem. The exam covers contents of both the lecture and the exercise class.	6 C

Admission requirements: keine	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Tim Friede
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Additional notes and regulations:
The actual examination type will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.MED.0004: Clinical Trials**	6 C 4 WLH

Learning outcome, core skills: **Inhalt:** Classification of clinical trials by purpose and development phase, clinical study protocol, randomization, treatment blinding, international guidelines on design, conduct and analysis of clinical trials, ethical issues in clinical trials, crossover trials, sample size calculation, internal pilot study design, group-sequential and adaptive designs, systematic reviews and meta-analyses of randomized controlled clinical trials. **Qualifikationsziele:** The students • learn about the foundations and general principles of design, conduct and analysis of clinical trials • get familiar with software to design clinical trials • learn how to carry out a meta-analysis using appropriate software.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Clinical Trials (Lecture)	2 WLH
2. Clinical Trials (Exercise)	2 WLH

Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points	6 C

Examination requirements: The students demonstrate their understanding of design, conduct and analysis of clinical trials. For a given problem they can critically assess the advantages and disadvantages of various study designs. They can plan a study using appropriate software. Furthermore, they can carry out a meta-analysis of randomized controlled trials, assess it for biases and heterogeneity, and interpret the results. The exam covers contents of both the lecture and the exercise class.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Tim Friede
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
The actual examination type will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.MED.0006: Genetic Epidemiology**	6 C 4 WLH
Learning outcome, core skills: Studies in molecular / genetic epidemiology are investigating possible genetic components that are contributing to a disease or, more general, to a phenotype. The studies include population studies and family studies. The difference with classical epidemiology is mainly given by the incorporation of correlations of the genetic structures and of family members or close populations and by the highdimensionality oft many studies. The course will discuss the most important study types and statistical and epidemiological methods. The lecture will also give necessary introductions to genetics as well as epidemiology. The students learn about • the description of genetically co-determined phenotypes for diseases in populations and families • the discovery of risk faktors that are on one hand associated with the phenotype in the population or on the other hand provoke familial aggregations • the modelling of the role of genetic risk faktors for diseases on the population and family level • the prediction or risk calculation based on populations or families.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Genetic Epidemiology (Lecture)	2 WLH
2. Genetic Epidemiology (Exercise)	2 WLH

Examination: 1st part examination: ca. 30 minutes oral presentation and written draft (max.10 pages) - contents: critics of the references of 1-2 scientific articles. 2nd part examination: oral examination (ca. 20 minutes) **Examination prerequisites:** Constant attandance of excercises (80%). At least 50% of the earned points at regular homeworks. **Examination requirements:** 1. part examination: In the talk together with the write-up they demonstrate that they can apply their knowledge and understanding in the context of a literature by demonstrating an understanding of the study goals, the recruitment, the study design, the materials, the methods and the results. For all this an understanding of why investigators took certain choices and why certain aspects are good or bad are expected in the critique. In particular it is also expected that basic principle of the methods will be understand and looked up even if they are extensions of the direct material covered in class. 2nd part exmination: The students demonstrate their general understanding of genetic and statistical models and designs. They know about the advantages and disadvantages of the different research questions and designs. They know the general properties of the statistical	6 C

approaches and can critically assess the appropriateness for specific problems and apply them. The exam covers contents of both the lecture and the exercise class.	

Examination requirements: The students demonstrate their general understanding of genetic and statistical models and designs. They know about the advantages and disadvantages of the different research questions and designs. They know the general properties of the statistical approaches and can critically assess the appropriateness for specific problems and apply them. The exam covers contents of both the lecture and the exercise class.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Heike Bickeböller
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.MM.003: Animal Experimental Course**	4 C 3 WLH

Learning outcome, core skills: The course includes a theoretical and practical part. The theoretical part includes: legislation, biology and husbandry of laboratory animals, microbiology and diseases, alternatives to animal use, anesthesia, analgesia, and experimental procedures. After participating in the practical part the students should be able to handle small laboratory animals (mouse, rat) according to the animal welfare act. The practical course contains handling, fixation, application and sampling techniques and euthanasia.	**Workload:** Attendance time: 42 h Self-study time: 78 h

Courses:	
1. Lecture "Introduction to laboratory animal science" (Block course)	1,5 WLH
2. Animal Experimental Course (Exercise)	1,5 WLH
Examination: Written examination (30 minutes) **Examination requirements:** The students should comprehend and reproduce the contents of the courses.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dipl.-Biol. Julia Hanni Steinbrecher
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.MM.005: English for Scientists**	4 C 2 WLH
Learning outcome, core skills: In the course "English for Scientists" the students extend their knowledge of the English language in a scientific context at an advanced level. The emphasis in the course for Masters students is on the skills required in positions of responsibility and leadership. The participants will learn to communicate in international situations successfully and with self-confidence in both spoken and written English. After completing the module, the students will be familiar with the fundamentals of: formal writing for the purpose of acquiring research partners and sponsors, telephoning internationally, meetings, and the planning of a visit by international partners. Linguistic abilities will also be promoted by discussion of further relevant themes such as "leadership" and "cultural differences in business" in English.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: English for Scientists (Seminar)	2 WLH
Examination: Written examination (60 minutes) **Examination requirements:** Composition of a research application in English. Carrying out telephone calls in English. Discussing confidently in English. Planning a visit by international partners.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Mark Wigfall
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.MM.101: Biomolecules and Pathogens	24 C 23 WLH

Learning outcome, core skills:	**Workload:**
In the course of the module the students will aquire deepened molecular knowledge of the interplay between pathogens and the host defense, immunological diseases and pharmacological approaches to interfere with various disorders. The graduates know current immunological questions and methods, and are able to explain the mechanism and therapy of related diseases. They know the function and regulation of microbial virulence factors and understand their role in the pathogenesis of infectious diseases. In addition, they have extensive insight into the taxonomy and structure of viruses. The graduates know the principles of pharmacological research and current therapeutic strategies. They can apply concepts of pharmacology to practical examples and name effects of selected toxic substances. The graduates have the ability to work under supervision on a small defined scientific project using experimental methods, and to analyze and interpret the obtained data. They are able to present their results in a seminar, and to discuss and document them in written form similar to a scientific publication.	Attendance time: 322 h Self-study time: 398 h

Course: "Biomolecules and Pathogens" (Lecture, Seminar)	8 WLH
Examination: Written examination (180 minutes) **Examination prerequisites:** Active participation in the seminar. **Examination requirements:** Deepened knowledge of clinically relevant pathogens and their mechanisms, basic concepts of immune responses and their failure, and current principles of pharmacological therapy of selected diseases.	12 C

Course: Praktikum (Practical course)	15 WLH
Examination: Presentation (ca. 30 Min.) with written draft (max. 20 pages) **Examination requirements:** Practical application of typical experimental methods to elucidate molecular, cellular and pathophysiological processes, and conclusive presentation of the obtained research results.	12 C

Admission requirements: Bachelor’s degree in a related study program or successfully passed first exam in human medicine	**Recommended previous knowledge:** Basic lectures in microbiology, virology, immunology and pharmacology.
Language: English	**Person responsible for module:** Prof. Dr. rer. nat. Holger Reichardt
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2

Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.MM.102: From cells to disease mechanism	24 C 24 WLH
Learning outcome, core skills: After successfully finishing this module the students should be familiar with molecular processes within the cell and corresponding aspects associated with pathological changes and pathological tissues. They are able to describe qualitatively genetic and metabolic diseases as well as inflammatory and cancerous processes. The students are familiar with tools, concepts and methods of cell biology, pathology, human genetics and molecular/experimental oncology and thus be able to describe causes and consequences of changes within genetic and cellular processes by using typical examples. Furthermore, fundamental mechanisms in pathology, genetics and cell biology are deduced. In addition, under qualified supervision students aquire the ability to perform experimental work within the lab covering a clear cut issue. The results of this practical course will be presented within the corresponding scientific group and written down in corresponding scientific style.	**Workload:** Attendance time: 336 h Self-study time: 384 h

Course: "From cells to disease mechanism" (Lecture, Seminar)	9 WLH
Examination: Written examination (180 minutes) **Examination prerequisites:** Active participation within the seminar. **Examination requirements:** Knowledge about fundamental mechanisms in gene regulation, extended knowledge about principles in cell communications and intracellular signaling processes, mechanisms of feedback/-forward regulatory circuits in cell signaling, Hallmarks of cancer, criteria of cell transformation in in vitro und in vivo assays, models of tumor develoment and therapy, tools to investigate cancer cells, current concepts in cancer therapy, tumor associated viruses and their mode of action, tumorsuppressor genes and oncogenes: modern concepts and mode of action, mechanisms, regulation of cell cycle phases, cell cycle check-points, posttranslational modifications as ubiquitination and phosphorylation, regulation of mitosis and chromosome segregation, genetic instability in cancer and chromsomal aberrations (examples, formation and detection/diagnosis), general pathology of inflammation and tumor pathology, the stem cell concept, concepts about the evolution of immune related genes, genetics of inflammatory reactions/ diseases and analysis of prehistorical DNA in the context of concepts of Anthroplogy, selected topic of molecular and translational oncology and hematological neoplasias, knowledge about current methods to analyse DNA, proteome analysis for molecular medicine.	12 C

Course: Praktikum (Practical course)	15 WLH
Examination: Presentation (ca. 30 Min.) with written draft (max. 20 pages) **Examination requirements:** Characteristic tools, concepts and methods to analyse molecular processes within cells and in vivo models , use methods of diagnostics, coherent and conclusive presentation of experimental data establishd within the lab rotation.	12 C

Admission requirements: Bachelor’s degree in a related study program or successfully passed first exam in human medicine.	**Recommended previous knowledge:** Basic lectures in oncology, biochemistry, pathology, cell biology, molekular biology, dermatology und human genetics.
Language: English	**Person responsible for module:** Prof. Dr. Dieter Kube
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.MM.103: The disease-affected organism	24 C 23 WLH
Learning outcome, core skills: After successfully finishing this module the students should be familiar with molecular aspects of urological diseases including urological tumors and prostate cancer and with mechanisms playing a role in different kidney diseases like polycystic kidney disease, diabetic nephrophathy as well as with mechanisms leading to renal fibrosis. Moreover, the students should be familiar with mechanisms playing a role in neurodegenerative diseases resulting from protein misfolding like Alzheimer's and Parkinson's disease and other prionopathies. Understanding molecular mechanisms of motor neuronal diseases, cerebral vascular diseases and neuronal autoimmune diseases is a further goal of this module. In molecular cardiology the student become familiar with mechanisms of different forms of heart failure, mechanisms of arrhythmia and myocarditis and the role of stem cells in tissue regeneration. In pharmacology, this knowledge is supplemented with pharmacotherapeutic strategies in the treatment of hypertension, heart failure, arrhythmia, the metabolic syndrome and of thromboembolic events. An outlook on potential future therapies of cardiovascular diseases is given including gene therapy, stem-cell based therapies and tissue engineering. The students have the ability to work under supervision on a small defined scientific project using experimental methods, and to analyze and interpret the obtained data. They are able to present their results in a seminar, and to discuss and document them in written form similar to a scientific publication.	**Workload:** Attendance time: 322 h Self-study time: 398 h
Course: "The disease-affected organism" (Lecture, Seminar)	8 WLH
Examination: Written examination (180 minutes) **Examination prerequisites:** aktiv participation within the seminar **Examination requirements:** • Profound knowledge on molecular mechanisms of the in the module discussed diseases in the fields of urology, nephrology, neurology, neuropathology and cardiology • Basic knowledge of signs and symptoms of the respective diseases • Knowledge in options of pharmcotherapeutical strategies in cardiovascular diseases	12 C
Course: Praktikum (Practical course)	15 WLH
Examination: Presentation (ca. 30 Min.) with written draft (max. 20 Seiten) **Examination requirements:** In the presentation the student has to demonstrate that she/he has gained deeper insights in the molecular mechanism of a certain disease by working on a respective scientific question. Suitable methods and the obtained results should be critically discussed. In the written report, which should follow the format of a thesis, the necessary introduction, material and methods and the results has to be concisely described and in the discussion carefully set in the literature context.	12 C

Admission requirements: Bachelor’s degree in a related study program or successfully passed first exam in human medicine.	**Recommended previous knowledge:** Basic lectures in pharmakology, physiology, nephrology, cardiology, neurology und neuropathology.
Language: English	**Person responsible for module:** Prof. Dr. Susanne Lutz
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.MM.104: Current Topics in Molecular Medicine**	4 C 3 WLH
Learning outcome, core skills: After completion of the module, the participant is capable of communicating his own scientific projects to a broader audience of scientists. Furthermore, she/he is capable of introducing such an audience to a general topic of molecular medicine. She/He can summarize primary scientific literature and review articles in an overview talk. The participants will be capable of following seminar talks about a topic that they are not immediately familiar with. They are asking meaningful questions and have become able to discuss methodological approaches and scientific conclusions in a critical and constructive manner.	**Workload:** Attendance time: 42 h Self-study time: 78 h
Course: Current Topics in Molecular Medicine (Seminar)	3 WLH
Examination: Oral Presentation (approx. 30 minutes) **Examination requirements:** The seminar talk must be understandable and clearly structured. It should reflect broad knowledge regarding the scientific background. The questions behind the project should be derived from this background. Methods and results should be outlined understandably, and the conclusions should be presented in a way that the audience can follow. The participants are also required to actively contribute to the discussion, to ask questions, and to evaluate the above-mentioned aspects of the presentation.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. med. Matthias Dobbelstein
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.Mat.0731: Advanced practical course in scientific computing**	10 C 4 WLH

Learning outcome, core skills: **Learning outcome:** After having successfully completed the module, students are familiar with the analysis of problems in the area "Scientific computing" arising in practice. They • develop large programming projects doing individual or group work; • analyse complex data sets and process them; • use special numerical libraries; • are experienced with advanced methods for the numerical solution of applied problems; • are familiar with basic principles of modular and structured programming in the context of scientific computing. **Core skills:** After having successfully completed the module, students possess advanced practical experience in the area "Scientific computing". They will be able to • identify mathematical problems in applied problems and convert them into a mathematical model; • implement numerical algorithms in a programming language or a user system; • structure complex programming tasks such that they can be efficiently done by group work.	**Workload:** Attendance time: 56 h Self-study time: 244 h

Course: Advanced practical course in scientific computing (Internship)	4 WLH

Examination: Term Paper, max. 50 pages (not counted appendices), alternatively, presentation (appr. 30 minutes) **Examination prerequisites:** Committed participation in the practical course	10 C

Examination requirements: • analysis and systematisation of applied problems; • knowledge in special methods of optimisation; • good programming skills.	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.2300
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.0741: Advanced practical course in stochastics	10 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: After having successfully completed the module, students have deepened and expanded their knowledge of a stochastical simulation and analysis software that they acquired in the module "Practical course in stochastics". They have acquired advanced knowledge in project work in stochastics. They • autonomously implement and interpret more complex stochastical problems using suitable software; • autonomously write more complex programs using suitable software; • master some advanced methods of statistical data analysis and stochastical simulation like e. g. kernel density estimation, the Bootstrap method, the creation of random numbers, the EM algorithm, survival analysis, the maximum-penalized-likelihood estimation and different test methods. **Core skills:** After having successfully completed the module, students will be able to • handle practical problems with the aid of advanced stochastical methods and the suitable stochastical simulation and analysis software and present the obtained results well; • use advanced visualisation methods for statistical data (e. g. of spatial data); • apply different algorithms to the suitable stochastical problem.	Attendance time: 84 h Self-study time: 216 h

Course: Advanced practical course in stochastics (Internship)	6 WLH

Examination: Presentation (appr. 30 minutes) and term paper (max. 50 pages not counted appendices) **Examination prerequisites:** Committed participation in the practical course	10 C

Examination requirements: Special knowledge in stochastics, especially mastery of complex stochastical simulation and analysis software as well as methods for data analysis	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.3140
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3

Maximum number of students: not limited	

Additional notes and regulations:

Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.0971: Internship	10 C (Anteil SK: 10 C)
Learning outcome, core skills: After having successfully completed the module, students have competencies in project-oriented and research-oriented team work as well as in project management. They are familiar with methods, tools and processes of mathematics as well as the organisational and social environment in practice.	**Workload:** Attendance time: 0 h Self-study time: 300 h
Examination: Presentation (appr. 20 minutes) and written report (max. 10 pages), not graded **Examination prerequisites:** Certificate of the successful completion of the posed duties in accordance with the internship contract	10 C
Examination requirements: Successfully handling of the posed duties according to the internship contract between the student and the enterprise.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4; Promotion: 1 - 6
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers of the Unit Mathematics

Georg-August-Universität Göttingen **Module M.Mat.3110: Higher analysis**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: Weighted differently depending on the current course offer, after having successfully passed the module, students are familiar with basic principles of functional analysis respectively the description of linear elliptical differential equations in functional analysis. They • are familiar with the most known examples of function and sequence spaces like spaces of continuous functions, Lp, lp and Sobolev spaces on bounded and unbounded areas; • identify compactness of operators and analyse the solvability of general linear operator equations, especially of boundary value problems for linear elliptical differential equations with variable coefficients with the aid of the Riesz Fredholm theory; • analyse the regularity of solutions of elliptical boundary value problems inside the domain in question and on its boundary; • use basic theorems of linear operators in Banach spaces, especially the Banach-Steinhaus theorem, the Hahn-Banach theorem and the open mapping theorem; • discuss weak convergence concepts and basic characteristics of dual and double-dual spaces; • are familiar with basic concepts of spectral theory and the spectral theorem for bounded, self-adjoint operators. **Core skills:** After having successfully completed the module, students will be able to • formulate and analyse differential equations and other problems in the language of functional analysis; • identify and describe the relevance of characteristics of functional analysis like choice of a suitable function space, completeness, boundedness or compactness; • evaluate the influence of boundary conditions and function spaces for existence, uniqueness and stability of solutions of differential equations.	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Functional analysis / Partial differential equations (Lecture)	4 WLH
2. Functional analysis / Partial differential equations - exercise session (Exercise)	2 WLH

Examination: Written examination (120 minutes)	9 C
Examination prerequisites: M.Mat.3110.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements:	

Proof of the advanced knowledge about functional analysis or partial differential equations	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.0021, B.Mat.0022, B.Mat.1100
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Bachelor: 4 - 6; Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:

- **Instructor:** Lecturers at the Mathematical Institute or at the Institute of Numerical and Applied Mathematics
- **Written examination:** This module can be completed by taking a lecture course counting towards the modules B.Mat.2100 or B.Mat.2110. Compared to the exams of the modules B.Mat.2100 respectively B.Mat.2110, exams of the module "Higher analysis" have a higher level of difficulty and test advanced knowledge.
- **Exclusions:** The module "Higher analysis" cannot be completed by taking a lecture course that has already been accounted in the Bachelor's studies.

Georg-August-Universität Göttingen Module M.Mat.3130: Operations research	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of the module enables students to learn methods, concepts, theories and applications in the area of the theory of operations research. Depending on the current course offer the following content-related competencies may be pursued. Students • are able to identify problems of operations research in application-oriented problems and formulate them as optimisation problems; • know methods for the modelling of application-oriented problems and are able to apply them; • evaluate the target function included in a model and the side conditions on the basis of their particular important characteristics; • analyse the complexity of the particular resulting optimisation problem; • are able to develop optimisation methods for the solution of a problem of operation research or adapt general methods to special problems; • know methods with which the quality of optimal solutions can be estimated to the upper and lower and apply them to the problem in question; • differentiate between accurate solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing time; • interpret the found solutions for the underlying practical problem and evaluate the model and solution method on this basis. **Core skills:** After having successfully completed the module, students will be able to • discuss basic concepts of the area "Operations research"; • explain basic ideas of proof in the area "Operations research"; • identify typical applications in the area "Operations research".	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination, appr. 20 minutes, alternatively written examination, 120 minutes **Examination prerequisites:** M.Mat.3130.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Successful proof of the acquired skills and competencies in the area "Operations research"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.2310
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.3140: Mathematical statistics**	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** After having successfully completed the module "Mathematical statistics", students are familiar with the basic concepts and methods of mathematical statistics. They • understand most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and are able to use them in simple models of mathematical statistics; • evaluate statistical methods mathematically precisely, amongst others via suitable risk and loss concepts; • analyse optimality characteristics of statistical estimate methods via lower and upper bounds; • are familiar with basic statistical distribution models; • are familiar with references of mathematical statistics to other mathematical areas. **Core skills:** After having successfully completed the module, students have acquired basic competencies in mathematical statistics. They will be able to • apply statistical ways of thinking as well as basic mathematical methods of statistics; • formulate statistical models mathematical precisely; • analyse practical statistical problems mathematically precisely with the learned methods.	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Written examination, 120 minutes, alternatively, oral examination, appr. 20 minutes **Examination prerequisites:** M.Mat.3140.Ue: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Successful proof of the acquired skills and competencies in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.1400
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

once a year	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4511: Specialisation in analytic number theory	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Analytic number theory"; • prepare substantial ideas of proof in the area "Analytic number theory".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes)	9 C
Examination prerequisites: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements:	
Proof of the acquisition of special skills and the mastery of special knowledge in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3311
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3311 "Advances in analytic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4512: Specialisation in analysis of partial differential equations**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalised functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Analysis of partial differential equations"; • prepare substantial ideas of proof in the area "Analysis of partial differential equations".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes)	9 C

Examination prerequisites: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3312
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3312 "Advances in analysis of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4513: Specialisation in differential geometry	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, surfaces and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Differential geometry"; • prepare substantial ideas of proof in the area "Differential geometry".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:	

Proof of the acquisition of special skills and the mastery of special knowledge in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3313
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3313 "Advances in variational analysis"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4514: Specialisation in algebraic topology	9 C 6 WLH

Learning outcome, core skills:	Workload:
Learning outcome: In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students • know the basic concepts of set-theoretic topology and continuous mappings; • construct new topologies from given topologies; • know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds; • apply basic concepts of category theory to topological spaces; • use concepts of functors to obtain algebraic invariants of topological spaces and mappings; • know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them; • know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems; • calculate homology and cohomology with the aid of chain complexes; • deduce algebraic characteristics of homology and cohomology with the aid of homological algebra; • become acquainted with connections between analysis and topology; • apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Algebraic topology"; • prepare substantial ideas of proof in the area "Algebraic topology".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH

2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3314
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3314 "Advances in algebraic topology"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4515: Specialisation in mathematical methods in physics**	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are

- harmonic analysis, algebraic structures and representation theory, (group) effects;
- operator algebra, C* algebra and von-Neumann algebra;
- operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions;
- (semi) Riemannian geometry, symplectic and Poisson geometry, quantization.

One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves.

Core skills:

After having successfully completed the module, students will be able to

- enhance concepts and methods for special problems and applications in the area "Mathematical methods of physics";
- prepare substantial ideas of proof in the area "Mathematical methods of physics".

Workload:
Attendance time:
84 h
Self-study time:
186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:
Proof of the acquisition of special skills and the mastery of special knowledge in the area "Mathematical methods in physics"

Admission requirements:	**Recommended previous knowledge:**
none	B.Mat.3315

Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3315 "Advances in mathematical methods in physics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4521: Specialisation in algebraic geometry**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Algebraic geometry""; • prepare substantial ideas of proof in the area "Algebraic geometry"".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:**	9 C

Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3321
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3321 "Advances in algebraic geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4522: Specialisation in algebraic number theory	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students

- know Noetherian and Dedekind rings and the class groups;
- are familiar with discriminants, differents and bifurcation theory of Hilbert;
- know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL);
- are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues;
- know densities, the Tchebotarew theorem and applications;
- work with orders, S-integers and S-units;
- know the class field theory of Hilbert, Takagi and Idele theoretical field theory;
- are familiar with Zp-extensions and their Iwasawa theory;
- discuss the most important hypotheses of Iwasawa theory and their consequences.

Concerning algorithmic aspects of number theory, the following competencies are pursued. Students

- work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors;
- are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests;
- use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics;
- discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields;
- calculate class groups and fundamental units;
- calculate Galois groups of absolute number fields.

Core skills:

After having successfully completed the module, students will be able to

- enhance concepts and methods for special problems and applications in the area "Algebraic number theory";
- prepare substantial ideas of proof in the area "Algebraic number theory".

Workload:

Attendance time:
84 h
Self-study time:
186 h

Courses: **1. Lecture course** (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3322
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3322 "Advances in algebraic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4523: Specialisation in algebraic structures	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Algebraic structures"; • prepare substantial ideas of proof in the area "Algebraic structures".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:**	9 C

Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3323
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3323 "Advances in algebraic structures"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4524: Specialisation in groups, geometry and dynamical systems**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Groups, geometry and dynamical systems"; • prepare substantial ideas of proof in the area "Groups, geometry and dynamical systems".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes)	9 C

Examination prerequisites: Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3324
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3324 "Advances in groups, geometry and dynamical systems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4525: Specialisation in non-commutative geometry	9 C 6 WLH

Learning outcome, core skills:	Workload:
Learning outcome: In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory; • construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains; • know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it; • know important examples of simple C*-algebras and deduce their basic characteristics; • apply basic concepts of category theory to C*-algebras; • model the symmetries of non-commutative spaces; • apply Hilbert modules in C*-algebras; • know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it; • apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales; • compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them; • classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations; • classify W*-algebras and know the intrinsic dynamic of factors; • apply von Neumann algebras to the axiomatic formulation of quantum field theory; • use von Neumann algebras for the construction of L2 invariants for manifolds and groups; • understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups; • define the invariants of algebras and modules with chain complexes and their homology and calculate these;	Attendance time: 84 h Self-study time: 186 h

- interpret these homological invariants geometrically and correlate them with each other;
- abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories.

Core skills:

After having successfully completed the module, students will be able to

- enhance concepts and methods for special problems and applications in the area "Non-commutative geometry";
- prepare substantial ideas of proof in the area "Non-commutative geometry".

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3325
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3325 "Advances in non-commutative geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4531: Specialisation in inverse problems	9 C 6 WLH

Learning outcome, core skills:	Workload:
Learning outcome: The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems; • evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors; • analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators; • analyse the convergence of regularisation methods with the help of complex analysis; • analyse regularisation methods from stochastic error models; • apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems; • model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region; • analyse the uniqueness and conditional stability of inverse problems of partial differential equations; • deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods; • formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Inverse problems"; • prepare substantial ideas of proof in the area "Inverse problems".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3331
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3331 "Advances in inverse problems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4532: Specialisation in approximation methods	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Approximation methods"; • prepare substantial ideas of proof in the area "Approximation methods".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3332
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3332 "Advances in approximation methods"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4533: Specialisation in numerical methods of partial differential equations**	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution; • know the basics of the theory of linear integral equations; • are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM); • analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems; • apply methods for adaptive lattice refinement on the basis of a posteriori error approximations; • know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation; • apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems; • apply available software for the solution of partial differential equations and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations; • know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Numerics of partial differential equations";	**Workload:** Attendance time: 84 h Self-study time: 186 h

• prepare substantial ideas of proof in the area "Numerics of partial differential equations".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Numerical methods of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3333
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3333 "Advances in numerical methods of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4534: Specialisation in optimisation**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • identify optimisation problems in application-oriented problems and formulate these as mathematical programmes; • evaluate the existence and uniqueness of the solution of an optimisation problem; • identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set; • know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised; • analyse the complexity of an optimisation problem; • classify a mathematical programme in a class of optimisation problems and know current solution strategies for it; • develop optimisation methods and adapt general methods to special problems; • deduce upper and lower bounds for optimisation problems and understand their meaning; • understand the geometrical structure of an optimisation problem and apply it for solution strategies; • distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times; • acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation; • acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning; • handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Optimisation"; • prepare substantial proof ideas in the area "Optimisation".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3334
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3334 "Advances in optimisation"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4537: Specialisation in variational analysis	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	Attendance time: 84 h Self-study time: 186 h

After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Variational analysis"; • prepare substantial ideas of proof in the area "Variational analysis".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3337
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3337 "Advances in variational analysis"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4538: Specialisation in image and geometry processing**	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e.g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces;
- learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces;
- learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform;
- learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces;
- acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies;
- know basic concepts and methods of topology;
- are familiar with visualisation software;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- know which special characteristics of an image or of a geometry can be extracted and worked on with which methods;
- evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data;
- are informed about current developments of efficient geometrical and topological data analysis;
- adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data.

Core skills:

After having successfully completed the module, students will be able to

- enhance concepts and methods for special problems and applications in the area "Image and geometry processing";
- prepare substantial ideas of proof in the area "Image and geometry processing".

Workload:

Attendance time:

84 h

Self-study time:

186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3338
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3338 "Advances in image and geometry processing"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4539: Specialisation in scientific computing / applied mathematics**	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Scientific computing / applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Scientific computing / applied mathematics"; • prepare substantial ideas of proof in the area "Scientific computing / applied mathematics".	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Scientific computing / applied mathematics	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3339
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3339 "Advances in scientific computing / applied mathematics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4541: Specialisation in applied and mathematical stochastics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economicsciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Applied and mathematical stochastics"; • prepare substantial ideas of proof in the area "Applied and mathematical stochastics".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3341
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3341 "Advances in applied and mathematical stochastics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4542: Specialisation in stochastic processes	9 C 6 WLH

Learning outcome, core skills:	Workload:
Learning outcome: The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces; • understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes; • know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes; • analyse regularity characteristics of the paths of stochastic processes; • construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics; • are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms; • analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems; • formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics; • are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes; • know fundamental convergence theorems for stochastic processes and generalise these; • model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes; • analyse models in mathematical economics and finance and understand evaluation methods for financial products. **Core skills:** After having successfully completed the module, students will be able to	Attendance time: 84 h Self-study time: 186 h

• enhance concepts and methods for special problems and applications in the area "Stochastic processes"; • prepare substantial ideas of proof in the area "Stochastic processes".	

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3342
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3342 "Advances in stochastic processes	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4543: Specialisation in stochastic methods in econo-mathematics	9 C 6 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Stochastic methods of economathematics"; • prepare substantial ideas of proof in the area "Stochastic methods of economathematics".	**Workload:** Attendance time: 84 h Self-study time: 186 h
Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C
Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Stochastic methods in economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3343
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:** 1 semester[s]

Usually subsequent to the module B.Mat.3343 "Advances in stochastic methods in economathematics"	
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4544: Specialisation in mathematical statistics**	9 C 6 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics; • evaluate statistical methods mathematically precisely via suitable risk and loss concepts; • analyse optimality characteristics of statistical estimate methods via lower and upper bounds; • analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory; • are familiar with basic statistical distribution models that base on the theory of exponential indexed families; • know different techniques to obtain lower and upper risk bounds in these models; • are confident in modelling typical data structures of regression; • analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand; • are able to mathematically analyse resampling methods and apply them purposively; • are familiar with advanced tools of non-parametric statistics and empirical process theory; • independently become acquainted with a current topic of mathematical statistics; • evaluate complex statistical methods and enhance them in a problem-oriented way. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Variational analysis"; • prepare substantial ideas of proof in the area "Variational analysis".	Attendance time: 84 h Self-study time: 186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3344
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3344 "Advances in mathematical statistics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4545: Specialisation in statistical modelling and inference**	9 C 6 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods for model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • enhance concepts and methods for special problems and applications in the area "Statistical modelling and inference"; • prepare substantial ideas of proof in the area "Statistical modelling and inference".	**Workload:** Attendance time: 84 h Self-study time: 186 h

Courses: **1. Lecture course** (Lecture) **2. Exercise session** (Exercise)	 4 WLH 2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements: Proof of the acquisition of special skills and the mastery of special knowledge in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3345
Language: English	**Person responsible for module:** Programme coordinator

Course frequency: Usually subsequent to the module B.Mat.3345 "Advances in statistical modelling and inference"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4546: Specialisation in multivariate statistics**	9 C 6 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with basic principles of statistic modelling as well as estimate and test theory;
- understand the basics of multivariate statistics;
- know the main features of the theory of empirical processes;
- master basic methods of multivariate extreme value theory;
- understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas;
- are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces;
- are especially familiar with concepts and methods of Directional Analysis and statistical Shape Analysis;
- apply statistical methods for data on manifolds and stratified spaces;
- are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose.

Core skills:

After having successfully completed the module, students will be able to

- enhance concepts and methods for special problems and applications in the area "Multivariate statistics";
- prepare substantial ideas of proof in the area "Multivariate statistics".

Workload:

Attendance time:

84 h

Self-study time:

186 h

Courses:	
1. Lecture course (Lecture)	4 WLH
2. Exercise session (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Achievement of at least 50% of the exercise points and presentation, twice, of solutions in the exercise sessions	9 C

Examination requirements:

Proof of the acquisition of special skills and the mastery of special knowledge in the area "Multivariate statistics"

Admission requirements:	**Recommended previous knowledge:**

none	B.Mat.3346
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module B.Mat.3346 "Advances in multivariate statistics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4611: Aspects of analytic number theory**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Analytic number theory"; • carry out scientific work under supervision in the area "Analytic number theory".	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3311
Language: English	**Person responsible for module:** Programme coordinator

Course frequency: Usually subsequent to the module M.Mat.4511 "Specialisation in analytic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4612: Aspects of analysis of partial differential equations**	6 C 4 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalized functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Analysis of partial differential equations"; • carry out scientific work under supervision in the area "Analysis of partial differential equations".	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3312
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4512 "Specialisation in analysis of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4613: Aspects of differential geometry**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, areas and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Differential geometry"; • carry out scientific work under supervision in the area "Differential geometry".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3313
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4513 "Specialisation in differential geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4614: Aspects of algebraic topology	6 C 4 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students

- know the basic concepts of set-theoretic topology and continuous mappings;
- construct new topologies from given topologies;
- know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds;
- apply basic concepts of category theory to topological spaces;
- use concepts of functors to obtain algebraic invariants of topological spaces and mappings;
- know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them;
- know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems;
- calculate homology and cohomology with the aid of chain complexes;
- deduce algebraic characteristics of homology and cohomology with the aid of homological algebra;
- become acquainted with connections between analysis and topology;
- apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Algebraic topology";
- carry out scientific work under supervision in the area "Algebraic topology".

Workload:
Attendance time:
56 h
Self-study time:
124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3314
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4514 "Specialisation in algebraic topology"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4615: Aspects of mathematical methods in physics	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are • harmonic analysis, algebraic structures and representation theory, (group) effects; • operator algebra, C* algebra and von-Neumann algebra; • operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions; • (semi) Riemannian geometry, symplectic and Poisson geometry, quantization. One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Mathematical methods of physics"; • carry out scientific work under supervision in the area "Mathematical methods of physics".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Mathematical methods in physics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3315
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:** 1 semester[s]

Usually subsequent to the module M.Mat.4515 "Specialisation in mathematical methods in physics"	
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4621: Aspects of algebraic geometry**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic geometry""; • carry out scientific work under supervision in the area "Algebraic geometry"".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements:	

Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3321
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4521 "Specialisation in algebraic geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4622: Aspects of algebraic number theory**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students • know Noetherian and Dedekind rings and the class groups; • are familiar with discriminants, differents and bifurcation theory of Hilbert; • know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL); • are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues; • know densities, the Tchebotarew theorem and applications; • work with orders, S-integers and S-units; • know the class field theory of Hilbert, Takagi and Idele theoretical field theory; • are familiar with Zp-extensions and their Iwasawa theory; • discuss the most important hypotheses of Iwasawa theory and their consequences. Concerning algorithmic aspects of number theory, the following competencies are pursued. Students • work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors; • are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests; • use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics; • discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields; • calculate class groups and fundamental units; • calculate Galois groups of absolute number fields. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic number theory"; • carry out scientific work under supervision in the area "Algebraic number theory".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3322
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4522 "Specialisation in algebraic number theory"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4623: Aspects of algebraic structures	6 C 4 WLH

Learning outcome, core skills:	Workload:
Learning outcome: In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic structures"; • carry out scientific work under supervision in the area "Algebraic structures".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements:	
Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3323
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4523 "Specialisation in Variational Analysis"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4624: Aspects of groups, geometry and dynamical systems**	6 C 4 WLH
Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Groups, geometry and dynamical systems"; • carry out scientific work under supervision in the area "Groups, geometry and dynamical systems".	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements:	

Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3324
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4524 "Specialisation in groups, geometry and dynamical systems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4625: Aspects of non-commutative geometry	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory; • construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains; • know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it; • know important examples of simple C*-algebras and deduce their basic characteristics; • apply basic concepts of category theory to C*-algebras; • model the symmetries of non-commutative spaces; • apply Hilbert modules in C*-algebras; • know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it; • apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales; • compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them; • classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations; • classify W*-algebras and know the intrinsic dynamic of factors; • apply von Neumann algebras to the axiomatic formulation of quantum field theory; • use von Neumann algebras for the construction of L2 invariants for manifolds and groups; • understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups; • define the invariants of algebras and modules with chain complexes and their homology and calculate these;	Attendance time: 56 h Self-study time: 124 h

• interpret these homological invariants geometrically and correlate them with each other; • abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Non-commutative geometry"; • carry out scientific work under supervision in the area "Non-commutative geometry".	

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3325
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4525 "Specialisation in non-commutative geometry"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4631: Aspects of inverse problems**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems; • evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors; • analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators; • analyse the convergence of regularisation methods with the help of complex analysis; • analyse regularisation methods from stochastic error models; • apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems; • model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region; • analyse the uniqueness and conditional stability of inverse problems of partial differential equations; • deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods; • formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Inverse problems"; • carry out scientific work under supervision in the area "Inverse problems".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3331
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4531 "Specialisation in inverse problems"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4632: Aspects of approximation methods	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Approximation methods"; • carry out scientific work under supervision in the area "Approximation methods".	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3332
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4532 "Specialisation in approximation methods"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4633: Aspects of numerical methods of partial differential equations**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution; • know the basics of the theory of linear integral equations; • are familiar with the basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM); • analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems; • apply methods for adaptive lattice refinement on the basis of a posteriori error approximations; • know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation; • apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems; • apply available software for the solution of partial differential equations and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations; • know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Numerics of partial differential equations";	**Workload:** Attendance time: 56 h Self-study time: 124 h

• carry out scientific work under supervision in the area "Numerics of partial differential equations".	

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Numerical methods of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3333
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4533 "Specialisation in numerical methods of partial differential equations"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4634: Aspects of optimisation**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • identify optimisation problems in application-oriented problems and formulate these as mathematical programmes; • evaluate the existence and uniqueness of the solution of an optimisation problem; • identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set; • know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised; • analyse the complexity of an optimisation problem; • classify a mathematical programme in a class of optimisation problems and know current solution strategies for it; • develop optimisation methods and adapt general methods to special problems; • deduce upper and lower bounds for optimisation problems and understand their meaning; • understand the geometrical structure of an optimisation problem and apply it for solution strategies; • distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times; • acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation; • acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning; • handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Optimisation"; • carry out scientific work under supervision in the area "Optimisation".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3334
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4534 "Specialisation in optimisation"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4637: Aspects of variational analysis	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	**Workload:** Attendance time: 56 h Self-study time: 124 h

After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Variational analysis"; • carry out scientific work under supervision in the area "Variational analysis".	

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Variational analysis".	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3337
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4537 "Specialisation in Variational Analysis"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4638: Aspects of image and geometry processing**	6 C 4 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces; • learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces; • learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform; • learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces; • acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies; • know basic concepts and methods of topology; • are familiar with visualisation software; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • know which special characteristics of an image or of a geometry can be extracted and worked on with which methods; • evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data; • are informed about current developments of efficient geometrical and topological data analysis; • adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Image and geometry processing"; • carry out scientific work under supervision in the area "Image and geometry processing".	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3338
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4538 "Specialisation in image and geometry processing"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4639: Aspects of scientific computing / applied mathematics	6 C 4 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Scientific computing / Applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / Applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions;
- know basic methods for the numerical solution of these models;
- analyse stability, convergence and efficiency of numerical solution strategies;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time;
- are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware;
- use methods of scientific computing for solving application problems, like e. g. of natural and business sciences.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Scientific computing / Applied mathematics";
- carry out scientific work under supervision in the area "Scientific computing / Applied mathematics".

Workload:
Attendance time:
56 h
Self-study time:
124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3339
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4539 "Specialisation in scientific computing / applied mathematics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4641: Aspects of applied and mathematical stochastics**	6 C 4 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Applied and mathematical stochastics"; • carry out scientific work under supervision in the area "Applied and mathematical stochastics".	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3341
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4541 "Specialisation in applied and mathematical stochastics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4642: Aspects of stochastic processes	6 C 4 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with advanced concepts of probability theory established on measure theory and apply them independently;
- know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces;
- understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes;
- know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes;
- analyse regularity characteristics of the paths of stochastic processes;
- construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics;
- are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms;
- analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems;
- formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics;
- are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes;
- know fundamental convergence theorems for stochastic processes and generalise these;
- model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes;
- analyse models in mathematical economics and finance and understand evaluation methods for financial products.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Stochastic processes";

Workload:

Attendance time:

56 h

Self-study time:

124 h

• carry out scientific work under supervision in the area "Stochastic processes".	

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3342
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4542 "Specialisation in stochastic processes"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4643: Aspects of stochastics methods of economathematics**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Stochastic methods of economathematics"; • carry out scientific work under supervision in the area "Stochastic methods of economathematics".	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Stochastics methods of economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3343
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4543 "Specialisation in stochastics methods of economathematics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3

Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4644: Aspects of mathematical statistics**	6 C 4 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics;
- evaluate statistical methods mathematically precisely via suitable risk and loss concepts;
- analyse optimality characteristics of statistical estimate methods via lower and upper bounds;
- analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory;
- are familiar with basic statistical distribution models that base on the theory of exponential indexed families;
- know different techniques to obtain lower and upper risk bounds in these models;
- are confident in modelling typical data structures of regression;
- analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand;
- are able to mathematically analyse resampling methods and apply them purposively;
- are familiar with advanced tools of non-parametric statistics and empirical process theory;
- independently become acquainted with a current topic of mathematical statistics;
- evaluate complex statistical methods and enhance them in a problem-oriented way.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Mathematical statistics";
- carry out scientific work under supervision in the area "Mathematical statistics".

Workload:
Attendance time:
56 h
Self-study time:
124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3344
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4544 "Specialisation in mathematical statistics"	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4645: Aspects of statistical modelling and inference**	6 C 4 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods for model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Statistical modelling and inference"; • carry out scientific work under supervision in the area "Statistical modelling and inference".	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH
Examination: Oral examination (approx. 20 minutes)	6 C
Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3345
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: Usually subsequent to the module M.Mat.4545 "Specialisation in statistical modelling and inference"	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:

Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4646: Aspects of multivariate statistics	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistic modelling as well as estimate and test theory; • understand the basics of multivariate statistics; • know the main features of the theory of empirical processes; • master basic methods of multivariate extreme value theory; • understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas; • are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces; • are especially familiar with concepts and methods of directional analysis and statistical shape analysis; • apply statistical methods for data on manifolds and stratified spaces; • are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Multivariate statistics"; • carry out scientific work under supervision in the area "Multivariate statistics".	Attendance time: 56 h Self-study time: 124 h

Course: Lecture course (4 WLH); alternatively lecture course (2 WLH) with exercises/seminar (2 WLH)	4 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Proof of the acquisition of special skills and the mastery of advanced competencies in the area "Multivariate statistics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4546
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

Usually subsequent to the module M.Mat.4546 "Specialisation in multivariate statistics"	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4711: Special course in analytic number theory	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Analytic number theory"; • become acquainted with special problems in the area "Analytic number theory" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3311
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

not specified	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4712: Special course in analysis of partial differential equations**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalised functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Analysis of partial differential equations"; • become acquainted with special problems in the area "Analysis of partial differential equations" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements:	

Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3312
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4713: Special course in differential geometry	3 C 2 WLH

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Learning outcome, core skills:
Learning outcome:

The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- master the basic concepts of differential geometry;
- develop a spatial sense using the examples of curves, surfaces and hypersurfaces;
- develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability";
- master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory;
- develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods;
- acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems;
- are able to import geometrical problems to a broader mathematical and physical context.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Differential geometry";
- become acquainted with special problems in the area "Differential geometry" to carry out scientific work for it.

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Workload:
Attendance time:
28 h
Self-study time:
62 h

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Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3313

Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4714: Special course in algebraic topology	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students

- know the basic concepts of set-theoretic topology and continuous mappings;
- construct new topologies from given topologies;
- know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds;
- apply basic concepts of category theory to topological spaces;
- use concepts of functors to obtain algebraic invariants of topological spaces and mappings;
- know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them;
- know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems;
- calculate homology and cohomology with the aid of chain complexes;
- deduce algebraic characteristics of homology and cohomology with the aid of homological algebra;
- become acquainted with connections between analysis and topology;
- apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Algebraic topology";
- become acquainted with special problems in the area "Algebraic topology" to carry out scientific work for it.

Workload:

Attendance time:

28 h

Self-study time:

62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3314
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4715: Special course in mathematical methods in physics**	3 C 2 WLH

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Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are

- harmonic analysis, algebraic structures and representation theory, (group) effects;
- operator algebra, C* algebra and von-Neumann algebra;
- operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions;
- (semi) Riemannian geometry, symplectic and Poisson geometry, quantization.

One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Mathematical methods of physics";
- become acquainted with special problems in the area "Mathematical methods of physics" to carry out scientific work for it.

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Workload:
Attendance time:
28 h
Self-study time:
62 h

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Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Mathematical methods in physics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3315
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4721: Special course in algebraic geometry	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic geometry"; • become acquainted with special problems in the area "Algebraic geometry" to carry out scientific work for it.	Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements:	

Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3321
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4722: Special course in algebraic number theory**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students • know Noetherian and Dedekind rings and the class groups; • are familiar with discriminants, differents and bifurcation theory of Hilbert; • know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL); • are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues; • know densities, the Tchebotarew theorem and applications; • work with orders, S-integers and S-units; • know the class field theory of Hilbert, Takagi and Idele theoretical field theory; • are familiar with Zp-extensions and their Iwasawa theory; • discuss the most important hypotheses of Iwasawa theory and their consequences. Concerning algorithmic aspects of number theory, the following competencies are pursued. Students • work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors; • are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests; • use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics; • discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields; • calculate class groups and fundamental units; • calculate Galois groups of absolute number fields. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic number theory"; • become acquainted with special problems in the area "Algebraic number theory" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Algebraic number theory	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3322
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4723: Special course in algebraic structures	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Algebraic structures"; • become acquainted with special problems in the area "Algebraic structures" to carry out scientific work for it.	Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3323
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4724: Special course in groups, geometry and dynamical systems**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Groups, geometry and dynamical systems"; • become acquainted with special problems in the area "Groups, geometry and dynamical systems" to carry out scientific work for it.	Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements:	

Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3324
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4725: Special course in non-commutative geometry**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory; • construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains; • know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it; • know important examples of simple C*-algebras and deduce their basic characteristics; • apply basic concepts of category theory to C*-algebras; • model the symmetries of non-commutative spaces; • apply Hilbert modules in C*-algebras; • know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it; • apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales; • compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them; • classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations; • classify W*-algebras and know the intrinsic dynamic of factors; • apply von Neumann algebras to the axiomatic formulation of quantum field theory; • use von Neumann algebras for the construction of L2 invariants for manifolds and groups; • understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups; • define the invariants of algebras and modules with chain complexes and their homology and calculate these;	Attendance time: 28 h Self-study time: 62 h

• interpret these homological invariants geometrically and correlate them with each other; • abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Non-commutative geometry"; • become acquainted with special problems in the area "Non-commutative geometry" to carry out scientific work for it.	

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3325
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4731: Special course in inverse problems**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems;
- evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors;
- analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators;
- analyse the convergence of regularisation methods with the help of complex analysis;
- analyse regularisation methods from stochastic error models;
- apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems;
- model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region;
- analyse the uniqueness and conditional stability of inverse problems of partial differential equations;
- deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods;
- formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Inverse problems";
- become acquainted with special problems in the area "Inverse problems" to carry out scientific work for it.

Workload:
Attendance time:
28 h
Self-study time:
62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3331
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4732: Special course in approximation methods**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Approximation methods"; • become acquainted with special problems in the area "Approximation methods" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3332
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4733: Special course in numerical methods of partial differential equations**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution;
- know the basics of the theory of linear integral equations;
- are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM);
- analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems;
- apply methods for adaptive lattice refinement on the basis of a posteriori error approximations;
- know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation;
- apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems;
- apply available software for the solution of partial differential equations and evaluate the results sceptically;
- evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations;
- know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Variational analysis";
- become acquainted with special problems in the area "Variational analysis" to carry out scientific work for it.

Workload:

Attendance time:
28 h

Self-study time:
62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area Numerical nethods of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3333
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4734: Special course in optimisation**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- identify optimisation problems in application-oriented problems and formulate these as mathematical programmes;
- evaluate the existence and uniqueness of the solution of an optimisation problem;
- identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set;
- know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised;
- analyse the complexity of an optimisation problem;
- classify a mathematical programme in a class of optimisation problems and know current solution strategies for it;
- develop optimisation methods and adapt general methods to special problems;
- deduce upper and lower bounds for optimisation problems and understand their meaning;
- understand the geometrical structure of an optimisation problem and apply it for solution strategies;
- distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times;
- acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation;
- acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning;
- handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Optimisation";
- become acquainted with special problems in the area "Optimisation" to carry out scientific work for it.

Workload:

Attendance time:
28 h

Self-study time:
62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3334
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: on an irregular basis	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4737: Special course in variational analysis	3 C 2 WLH

Learning outcome, core skills:	Workload:

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems;
- master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems;
- understand basic concepts of the convergence of sets and continuity of set-valued functions;
- understand basic concepts of variational geometry;
- calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions;
- understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals;
- analyse constrained and parametric optimisation problems with the help of duality theory;
- calculate and use the Legendre-Fenchel transformation and infimal convulutions;
- formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis;
- apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria;
- understand the connection between convex functions and monotone operators;
- examine the convergence of fixed point iterations with the help of the theory of monotone operators;
- deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence;
- apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems;
- model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations;
- know applications of control theory and apply methods of dynamic programming;
- use tools of variational analysis in image processing and with inverse problems;
- know basic concepts and methods of stochastic optimisation.

Core skills:

Workload:

Attendance time:

28 h

Self-study time:

62 h

After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Variational analysis"; • become acquainted with special problems in the area "Variational analysis" to carry out scientific work for it.	
Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3337
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4738: Special course in image and geometry processing**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces;
- learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces;
- learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform;
- learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces;
- acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies;
- know basic concepts and methods of topology;
- are familiar with visualisation software;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- know which special characteristics of an image or of a geometry can be extracted and worked on with which methods;
- evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data;
- are informed about current developments of efficient geometrical and topological data analysis;
- adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Image and geometry processing";

Workload:

Attendance time:

28 h

Self-study time:

62 h

• become acquainted with special problems in the area "Image and geometry processing" to carry out scientific work for it.	
Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3338
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4739: Special course in scientific computing / applied mathematics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Scientific computing / applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Scientific computing / applied mathematics"; • become acquainted with special problems in the area "Scientific computing / applied mathematics" to carry out scientific work for it.	Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3339
Language: English	**Person responsible for module:** Programme coordinator

Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4741: Special course in applied and mathematical stochastics**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students

- are familiar with advanced concepts of probability theory established on measure theory and apply them independently;
- are familiar with substantial concepts and approaches of probability modelling and inferential statistics;
- know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness;
- have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples;
- understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy;
- analyse the convergence characteristic of stochastic processes;
- analyse regularity characteristics of the paths of stochastic processes;
- adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters;
- analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed;
- discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Applied and mathematical stochastics";
- become acquainted with special problems in the area "Applied and mathematical stochastics" to carry out scientific work for it.

Workload:
Attendance time:
28 h
Self-study time:
62 h

Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements:	

Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3341
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen Module M.Mat.4742: Special course in stochastic processes	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with advanced concepts of probability theory established on measure theory and apply them independently;
- know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces;
- understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes;
- know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes;
- analyse regularity characteristics of the paths of stochastic processes;
- construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics;
- are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms;
- analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems;
- formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics;
- are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes;
- know fundamental convergence theorems for stochastic processes and generalise these;
- model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes;
- analyse models in mathematical economics and finance and understand evaluation methods for financial products.

Core skills:

After having successfully completed the module, students will be able to

- conduct scholarly debates about problems of the area "Stochastic processes";

Workload:

Attendance time:

28 h

Self-study time:

62 h

• become acquainted with special problems in the area "Stochastic processes" to carry out scientific work for it.	

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3342
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen **Module M.Mat.4743: Special course in stochastic methods of econo-mathematics**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Stochastic methods of economathematics"; • become acquainted with special problems in the area "Stochastic methods of economathematics" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Stochastic methods of economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3343
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen Module M.Mat.4744: Special course in mathematical statistics	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics; • evaluate statistical methods mathematically precisely via suitable risk and loss concepts; • analyse optimality characteristics of statistical estimate methods via lower and upper bounds; • analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory; • are familiar with basic statistical distribution models that base on the theory of exponential indexed families; • know different techniques to obtain lower and upper risk bounds in these models; • are confident in modelling typical data structures of regression; • analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand; • are able to mathematically analyse resampling methods and apply them purposively; • are familiar with advanced tools of non-parametric statistics and empirical process theory; • independently become acquainted with a current topic of mathematical statistics; • evaluate complex statistical methods and enhance them in a problem-oriented way. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Mathematical statistics"; • become acquainted with special problems in the area "Mathematical statistics" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Lecture course (Lecture)	2 WLH

Examination: Oral examination (approx. 20 minutes)	3 C

Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3344
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen **Module M.Mat.4745: Special course in statistical modelling and inference**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods for model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Statistical modelling and inference"; • become acquainted with special problems in the area "Statistical modelling and inference" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3345
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen Module M.Mat.4746: Special course in multivariate statistics	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistic modelling as well as estimate and test theory; • understand the basics of multivariate statistics; • know the main features of the theory of empirical processes; • master basic methods of multivariate extreme value theory; • understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas; • are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces; • are especially familiar with concepts and methods of directional analysis and statistical shape analysis; • apply statistical methods for data on manifolds and stratified spaces; • are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose. **Core skills:** After having successfully completed the module, students will be able to • conduct scholarly debates about problems of the area "Multivariate statistics"; • become acquainted with special problems in the area "Multivariate statistics" to carry out scientific work for it.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture course (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	3 C
Examination requirements: Proof of the acquisition of further special skills and the mastery of advanced competencies in the area "Multivariate statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3346
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

not specified	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Statistics

Georg-August-Universität Göttingen **Module M.Mat.4811: Seminar on analytic number theory**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Analytic number theory" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3311
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4812: Seminar on analysis of partial differential equations**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the most important types of partial differential equations and know their solutions;
- master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations;
- are familiar with the theory of generalised functions and the theory of function spaces and use these for solving differential partial equations;
- apply the basic principles of functional analysis to the solution of partial different equations;
- use different theorems of function theory for solving partial different equations;
- master different asymptotic techniques to study characteristics of the solutions of partial different equations;
- are paradigmatically familiar with broader application areas of linear theory of partial different equations;
- are paradigmatically familiar with broader application areas of non-linear theory of partial different equations;
- know the importance of partial different equations in the modelling in natural and engineering sciences;
- master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Analysis of partial differential equations" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:

Attendance time:
28 h

Self-study time:
62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3312
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4813: Seminar on differential geometry	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, surfaces and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Differential geometry" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Seminar (Seminar)	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3313
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4814: Seminar on algebraic topology	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students

- know the basic concepts of set-theoretic topology and continuous mappings;
- construct new topologies from given topologies;
- know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds;
- apply basic concepts of category theory to topological spaces;
- use concepts of functors to obtain algebraic invariants of topological spaces and mappings;
- know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them;
- know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems;
- calculate homology and cohomology with the aid of chain complexes;
- deduce algebraic characteristics of homology and cohomology with the aid of homological algebra;
- become acquainted with connections between analysis and topology;
- apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Algebraic topology" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:

Attendance time:
28 h

Self-study time:
62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3314
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4815: Seminar on mathematical methods in physics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are • harmonic analysis, algebraic structures and representation theory, (group) effects; • operator algebra, C* algebra and von-Neumann algebra; • operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions; • (semi) Riemannian geometry, symplectic and Poisson geometry, quantization. One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Mathematical methods of physics" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Mathematical methods in physics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3315
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4821: Seminar on algebraic geometry	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Algebraic geometry" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Seminar (Seminar)	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements:	

Autonomous permeation and presentation of complex mathematical issues in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3321
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4822: Seminar on algebraic number theory	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students • know Noetherian and Dedekind rings and the class groups; • are familiar with discriminants, differents and bifurcation theory of Hilbert; • know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL); • are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues; • know densities, the Tchebotarew theorem and applications; • work with orders, S-integers and S-units; • know the class field theory of Hilbert, Takagi and Idele theoretical field theory; • are familiar with Zp-extensions and their Iwasawa theory; • discuss the most important hypotheses of Iwasawa theory and their consequences. Concerning algorithmic aspects of number theory, the following competencies are pursued. Students • work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors; • are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests; • use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics; • discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields; • calculate class groups and fundamental units; • calculate Galois groups of absolute number fields. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Variational analysis" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3322
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4823: Seminar on algebraic structures**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Algebraic structures" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Seminar (Seminar)	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements:	

Autonomous permeation and presentation of complex mathematical issues in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3323
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4824: Seminar on groups, geometry and dynamical systems**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis.

Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students

- know basic concepts of groups and group homomorphisms;
- know important examples of groups;
- know special classes of groups and their special characteristics;
- apply basic concepts of category theory to groups and define spaces via universal properties;
- apply the concepts of functors to obtain algebraic invariants;
- know group actions and their basic classification results;
- know the basics of group cohomology and compute these for important examples;
- know the basics of geometrical group theory like growth characteristics;
- know self-similar groups, their basic constructs as well as examples with interesting characteristics;
- use geometrical and combinatorial tools for the study of groups;
- know the basics of the representation theory of compact Lie groups.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Groups, geometry and dynamical systems" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:
Attendance time:
28 h
Self-study time:
62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements:

Autonomous permeation and presentation of complex mathematical issues in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3324
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4825: Seminar on non-commutative geometry**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory; • construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains; • know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it; • know important examples of simple C*-algebras and deduce their basic characteristics; • apply basic concepts of category theory to C*-algebras; • model the symmetries of non-commutative spaces; • apply Hilbert modules in C*-algebras; • know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it; • apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales; • compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them; • classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations; • classify W*-algebras and know the intrinsic dynamic of factors; • apply von Neumann algebras to the axiomatic formulation of quantum field theory; • use von Neumann algebras for the construction of L2 invariants for manifolds and groups; • understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups;	Attendance time: 28 h Self-study time: 62 h

- define the invariants of algebras and modules with chain complexes and their homology and calculate these;
- interpret these homological invariants geometrically and correlate them with each other;
- abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Non-commutative geometry" and present it in a talk;
- conduct scholarly debates in a familiar context.

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3325
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4831: Seminar on inverse problems**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems; • evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors; • analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators; • analyse the convergence of regularisation methods with the help of complex analysis; • analyse regularisation methods from stochastic error models; • apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems; • model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region; • analyse the uniqueness and conditional stability of inverse problems of partial differential equations; • deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods; • formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Inverse problems" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:**	3 C

Participation in the seminar	
Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3331
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4832: Seminar on approximation methods	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Approximation methods" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:**	3 C

Participation in the seminar	

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3332
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4833: Seminar on numerical methods of partial differential equations**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution;
- know the basics of the theory of linear integral equations;
- are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM);
- analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems;
- apply methods for adaptive lattice refinement on the basis of a posteriori error approximations;
- know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation;
- apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems;
- apply available software for the solution of partial differential equations and evaluate the results sceptically;
- evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations;
- know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Numerics of partial differential equations" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:

Attendance time:
28 h

Self-study time:
62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Numerical methods of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3333
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4834: Seminar on optimisation	3 C 2 WLH

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Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- identify optimisation problems in application-oriented problems and formulate these as mathematical programmes;
- evaluate the existence and uniqueness of the solution of an optimisation problem;
- identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set;
- know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised;
- analyse the complexity of an optimisation problem;
- classify a mathematical programme in a class of optimisation problems and know current solution strategies for it;
- develop optimisation methods and adapt general methods to special problems;
- deduce upper and lower bounds for optimisation problems and understand their meaning;
- understand the geometrical structure of an optimisation problem and apply it for solution strategies;
- distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times;
- acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation;
- acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning;
- handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Optimisation" and present it in a talk;
- conduct scholarly debates in a familiar context.

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Workload:

Attendance time:

28 h

Self-study time:

62 h

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Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3334
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4837: Seminar on variational analysis	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	Attendance time: 28 h Self-study time: 62 h

After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Variational analysis" and present it in a talk; • conduct scholarly debates in a familiar context.	

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3337
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4838: Seminar on image and geometry processing**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces;
- learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces;
- learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform;
- learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces;
- acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies;
- know basic concepts and methods of topology;
- are familiar with visualisation software;
- apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically;
- know which special characteristics of an image or of a geometry can be extracted and worked on with which methods;
- evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data;
- are informed about current developments of efficient geometrical and topological data analysis;
- adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Image and geometry processing" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:

Attendance time:

28 h

Self-study time:

62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3338
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4839: Seminar on scientific computing / applied mathematics**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Scientific computing / Applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / Applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Scientific computing / applied mathematics" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Seminar (Seminar)	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3339
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4841: Seminar on applied and mathematical stochastics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Applied and mathematical stochastics" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3341
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4842: Seminar on stochastic processes**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**

Learning outcome:

The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with advanced concepts of probability theory established on measure theory and apply them independently;
- know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces;
- understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes;
- know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes;
- analyse regularity characteristics of the paths of stochastic processes;
- construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics;
- are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms;
- analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems;
- formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics;
- are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes;
- know fundamental convergence theorems for stochastic processes and generalise these;
- model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes;
- analyse models in mathematical economics and finance and understand evaluation methods for financial products.

Core skills:

After having successfully completed the module, students will be able to

Attendance time:
28 h
Self-study time:
62 h

• become acquainted with a mathematical topic in the area "Variational analysis" and present it in a talk; • conduct scholarly debates in a familiar context.	

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3342
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4843: Seminar on stochastic methods of economathematics**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Stochastic methods of economathematics" and present it in a talk; • conduct scholarly debates in a familiar context.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Stochastic methods of economathematics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3343
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4844: Seminar on mathematical statistics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics; • evaluate statistical methods mathematically precisely via suitable risk and loss concepts; • analyse optimality characteristics of statistical estimate methods via lower and upper bounds; • analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory; • are familiar with basic statistical distribution models that base on the theory of exponential indexed families; • know different techniques to obtain lower and upper risk bounds in these models; • are confident in modelling typical data structures of regression; • analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand; • are able to mathematically analyse resampling methods and apply them purposively; • are familiar with advanced tools of non-parametric statistics and empirical process theory; • independently become acquainted with a current topic of mathematical statistics; • evaluate complex statistical methods and enhance them in a problem-oriented way. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Mathematical statistics" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:**	3 C

Participation in the seminar	

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3344
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4845: Seminar on statistical modelling and inference	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types;
- know Bayesian and common concepts for modelling and interference as well as their connection;
- master most important methods for model validation and model choice and know their theoretical characteristics;
- develop and validate numerical methods for model estimation and interference;
- deduce asymptotic characteristics of well-known statistical models;
- use modelling and interference for complex live data.

Core skills:

After having successfully completed the module, students will be able to

- become acquainted with a mathematical topic in the area "Statistical modelling and inference" and present it in a talk;
- conduct scholarly debates in a familiar context.

Workload:
Attendance time:
28 h
Self-study time:
62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3345
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4846: Seminar on multivariate statistics	3 C 2 WLH

Learning outcome, core skills:	Workload:
Learning outcome: The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistic modelling as well as estimate and test theory; • understand the basics of multivariate statistics; • know the main features of the theory of empirical processes; • master basic methods of multivariate extreme value theory; • understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas; • are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces; • are especially familiar with concepts and methods of directional analysis and statistical shape analysis; • apply statistical methods for data on manifolds and stratified spaces; • are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose. **Core skills:** After having successfully completed the module, students will be able to • become acquainted with a mathematical topic in the area "Multivariate statistics" and present it in a talk; • conduct scholarly debates in a familiar context.	Attendance time: 28 h Self-study time: 62 h

Course: Seminar (Seminar)	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues in the area "Multivariate statistics"	

Admission requirements: none	**Recommended previous knowledge:** B.Mat.3346
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4911: Advanced seminar on analytic number theory**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Analytic number theory" enables students to learn methods, concepts, theories and applications in the area of "Analytic number theory". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • solve arithmetical problems with basic, complex-analytical, and Fourier-analytical methods; • know characteristics of the Riemann zeta function and more general L-functions, and apply them to problems of number theory; • are familiar with results and methods of prime number theory; • acquire knowledge in arithmetical and analytical theory of automorphic forms, and its application in number theory; • know basic sieving methods and apply them to the problems of number theory; • know techniques used to estimate the sum of the sum of characters and of exponentials; • analyse the distribution of rational points on suitable algebraic varieties using analytical techniques; • master computation with asymptotic formulas, asymptotic analysis, and asymptotic equipartition in number theory. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Analytic number theory" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Analytic number theory"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4511
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4912: Advanced seminar on analysis of partial differential equations**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Analysis of partial differential equations" enables students to learn methods, concepts, theories and applications in the area "Analysis of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important types of partial differential equations and know their solutions; • master the Fourier transform and other techniques of the harmonic analysis to analyse partial differential equations; • are familiar with the theory of generalised functions and the theory of function spaces and use these for solving differential partial equations; • apply the basic principles of functional analysis to the solution of partial different equations; • use different theorems of function theory for solving partial different equations; • master different asymptotic techniques to study characteristics of the solutions of partial different equations; • are paradigmatically familiar with broader application areas of linear theory of partial different equations; • are paradigmatically familiar with broader application areas of non-linear theory of partial different equations; • know the importance of partial different equations in the modelling in natural and engineering sciences; • master some advanced application areas like parts of microlocal analysis or parts of algebraic analysis. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Analysis of partial differential equations" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Analysis of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4512
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4913: Advanced seminar on differential geometry**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Differential geometry" enables students to learn methods, concepts, theories and applications in the area "Differential geometry". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master the basic concepts of differential geometry; • develop a spatial sense using the examples of curves, surfaces and hypersurfaces; • develop an understanding of the basic concepts of differential geometry like "space" and "manifolds", "symmetry" and "Lie group", "local structures" and "curvature", "global structure" and "invariants" as well as "integrability"; • master (variably weighted and sorted depending on the current courses offered) the theory of transformation groups and symmetries as well as the analysis on manifolds, the theory of manifolds with geometric structures, complex differential geometry, gauge field theory and their applications as well as the elliptical differential equations of geometry and gauge field theory; • develop an understanding for geometrical constructs, spatial patterns and the interaction of algebraic, geometrical, analytical and topological methods; • acquire the skill to apply methods of analysis, algebra and topology for the treatment of geometrical problems; • are able to import geometrical problems to a broader mathematical and physical context. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Differential geometry" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Differential geometry"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4513
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4914: Advanced seminar on algebraic topology**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic topology" students get to know the most important classes of topological spaces as well as algebraic and analytical tools for studying these spaces and the mappings between them. The students use these tools in geometry, mathematical physics, algebra and group theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic topology uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic topology and supplement one another complementarily. The following content-related competencies are pursued. Students • know the basic concepts of set-theoretic topology and continuous mappings; • construct new topologies from given topologies; • know special classes of topological spaces and their special characteristics like CW complexes, simplicial complexes and manifolds; • apply basic concepts of category theory to topological spaces; • use concepts of functors to obtain algebraic invariants of topological spaces and mappings; • know the fundamental group and the covering theory as well as the basic methods for the computation of fundamental groups and mappings between them; • know homology and cohomology, calculate those for important examples and with the aid of these deduce non-existence of mappings as well as fixed-point theorems; • calculate homology and cohomology with the aid of chain complexes; • deduce algebraic characteristics of homology and cohomology with the aid of homological algebra; • become acquainted with connections between analysis and topology; • apply algebraic structures to deduce special global characteristics of the cohomology of a local structure of manifolds. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Algebraic topology" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Algebraic topology"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4514
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4915: Advanced seminar on mathematical methods in physics**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Mathematical methods of physics" students get to know different mathematical methods and techniques that play a role in modern physics. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. The topics of the cycle can be divided into four blocks, a cycle normally contains parts of different blocks, that topically supplement each other, but can also be read within one block. The introducing parts of the cycle form the basis for the advanced specialisation area. The topic blocks are • harmonic analysis, algebraic structures and representation theory, (group) effects; • operator algebra, C* algebra and von-Neumann algebra; • operator theory, perturbation and scattering theory, special PDE, microlocal analysis, distributions; • (semi) Riemannian geometry, symplectic and Poisson geometry, quantization. One of the aims is that a connection to physical problems is visible, at least in the motivation of the covered topics. Preferably, in the advanced part of the cycle, the students should know and be able to carry out practical applications themselves. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Mathematical methods of physics" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Mathematical methods in physics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4515
Language: English	**Person responsible for module:** Programme coordinator
Course frequency:	**Duration:**

not specified	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4921: Advanced seminar on algebraic geometry**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic geometry" students get to know the most important classes of algebraic varieties and schemes as well as the tools for studying these objects and the mappings between them. The students apply these skills to problems of arithmetic or complex analysis. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic geometry uses and connects concepts of algebra and geometry and can be used versatilely. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic geometry and supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with commutative algebra, also in greater detail; • know the concepts of algebraic geometry, especially varieties, schemes, sheafs, bundles; • examine important examples like elliptic curves, Abelian varieties or algebraic groups; • use divisors for classification questions; • study algebraic curves; • prove the Riemann-Roch theorem and apply it; • use cohomological concepts and know the basics of Hodge theory; • apply methods of algebraic geometry to arithmetical questions and obtain e. g. finiteness principles for rational points; • classify singularities and know the significant aspects of the dimension theory of commutative algebra and algebraic geometry; • get to know connections to complex analysis and to complex geometry. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Algebraic geometry" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements:	

Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Algebraic geometry"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4521
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen Module M.Mat.4922: Advanced seminar on algebraic number theory	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Algebraic number theory" enables students to learn methods, concepts, theories and applications in the areas "Algebraic number theory" and "Algorithmic number theory". During the course of the cycle students will be successively introduced to current theoretical and/or applied research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued in relation to algebra. Students • know Noetherian and Dedekind rings and the class groups; • are familiar with discriminants, differents and bifurcation theory of Hilbert; • know geometrical number theory with applications to the unit theorem and the finiteness of class groups as well as the algorithmic aspects of lattice theory (LLL); • are familiar with L-series and zeta functions and discuss the algebraic meaning of their residues; • know densities, the Tchebotarew theorem and applications; • work with orders, S-integers and S-units; • know the class field theory of Hilbert, Takagi and Idele theoretical field theory; • are familiar with Zp-extensions and their Iwasawa theory; • discuss the most important hypotheses of Iwasawa theory and their consequences. Concerning algorithmic aspects of number theory, the following competencies are pursued. Students • work with algorithms for the identification of short lattice bases, nearest points in lattices and the shortest vectors; • are familiar with basic algorithms of number theory in long arithmetic like GCD, fast number and polynomial arithmetic, interpolation and evaluation and prime number tests; • use the sieving method for factorisation and calculation of discrete logarithms in finite fields of great characteristics; • discuss algorithms for the calculation of the zeta function of elliptic curves and Abelian varieties of finite fields; • calculate class groups and fundamental units; • calculate Galois groups of absolute number fields. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Algebraic number theory" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Algebraic number theory"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4522
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4923: Advanced seminar on algebraic structures**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Algebraic structures" students get to know different algebraic structures, amongst others Lie algebras, Lie groups, analytical groups, associative algebras as well as the tools from algebra, geometry and category theory that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Algebraic structures use concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of algebraic structures and supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts like rings, modules, algebras and Lie algebras; • know important examples of Lie algebras and algebras; • know special classes of Lie groups and their special characteristics; • know classification theorems for finite-dimensional algebras; • apply basic concepts of category theory to algebras and modules; • know group actions and their basic classifications; • apply the enveloping algebra of Lie algebras; • apply ring and module theory to basic constructs of algebraic geometry; • use combinatorial tools for the study of associative algebras and Lie algebras; • acquire solid knowledge of the representation theory of Lie algebras, finite groups and compact Lie groups as well as the representation theory of semisimple Lie groups; • know Hopf algebras as well as their deformation and representation theory. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Algebraic structures" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements:	

Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Algebraic structures"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4523
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4924: Advanced seminar on groups, geometry and dynamical systems**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** In the modules of the cycle "Groups, geometry and dynamical systems" students get to know the most important classes of groups as well as the algebraic, geometrical and analytical tools that are necessary for their study and applications. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Group theory uses concepts and tools of algebra, geometry and analysis and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of the area "Groups, geometry and dynamical systems" that supplement one another complementarily. The following content-related competencies are pursued. Students • know basic concepts of groups and group homomorphisms; • know important examples of groups; • know special classes of groups and their special characteristics; • apply basic concepts of category theory to groups and define spaces via universal properties; • apply the concepts of functors to obtain algebraic invariants; • know group actions and their basic classification results; • know the basics of group cohomology and compute these for important examples; • know the basics of geometrical group theory like growth characteristics; • know self-similar groups, their basic constructs as well as examples with interesting characteristics; • use geometrical and combinatorial tools for the study of groups; • know the basics of the representation theory of compact Lie groups. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Groups, geometry and dynamical systems" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Advanced seminar	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C
Examination requirements:	

Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Groups, geometry and dynamical systems"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4524
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4925: Advanced seminar on non-commutative geometry**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: In the modules of the cycle "Non-commutative geometry" students get to know the conception of space of non-commutative geometry and some of its applications in geometry, topology, mathematical physics, the theory of dynamical systems and number theory. They are introduced to current research questions and enabled to carry out independent contributions to research, e. g. within the scope of a Master's thesis. Non-commutative geometry uses concepts of analysis, algebra, geometry and mathematical physics and can be applied to these areas. In the course offer several aspects are considered at a time and a cycle will only cover some of the learning objectives mentioned below. The introduction to the cycle and the specialisation in the cycle will normally cover different aspects of non-commutative geometry that supplement one another complementarily. The following content-related competencies are pursued. Students • are familiar with the basic characteristics of operator algebras, especially with their representation and ideal theory; • construct groupoids and operator algebras from different geometrical objects and apply non-commutative geometry to these domains; • know the spectral theory of commutative C*-algebras and analyse normal operators in Hilbert spaces with it; • know important examples of simple C*-algebras and deduce their basic characteristics; • apply basic concepts of category theory to C*-algebras; • model the symmetries of non-commutative spaces; • apply Hilbert modules in C*-algebras; • know the definition of the K-theory of C*-algebras and their formal characteristics and calculate the K-theory of C*-algebras for important examples with it; • apply operator algebras for the formulation and analysis of index problems in geometry and for the analysis of the geometry of greater length scales; • compare different analytical and geometrical models for the construction of mappings between K-theory groups and apply them; • classify and analyse quantisations of manifolds via Poisson structures and know a few important methods for the construction of quantisations; • classify W*-algebras and know the intrinsic dynamic of factors; • apply von Neumann algebras to the axiomatic formulation of quantum field theory; • use von Neumann algebras for the construction of L2 invariants for manifolds and groups; • understand the connection between the analysis of C*- and W*-algebras of groups and geometrical characteristics of groups; • define the invariants of algebras and modules with chain complexes and their homology and calculate these;	Attendance time: 28 h Self-study time: 62 h

- interpret these homological invariants geometrically and correlate them with each other;
- abstract new concepts from the fundamental characteristics of K-theory and other homology theories, e. g. triangulated categories.

Core skills:

After having successfully completed the module, students will be able to

- present a mathematical topic of current research interest in the area "Non-commutative geometry" in a talk;
- conduct scholarly debates with reference to current research.

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Non-commutative geometry"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4525
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Mathematical Institute

Georg-August-Universität Göttingen **Module M.Mat.4931: Advanced seminar on inverse problems**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Inverse problems" enables students to learn methods, concepts, theories and applications in the area of "Inverse problems". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the phenomenon of illposedness and identify the degree of illposedness of typical inverse problems; • evaluate different regularisation methods for ill posed inverse problems under algorithmic aspects and with regard to various a priori information and distinguish concepts of convergence for such methods with deterministic and stochastic data errors; • analyse the convergence of regularisation methods with the help of spectral theory of bounded self-adjoint operators; • analyse the convergence of regularisation methods with the help of complex analysis; • analyse regularisation methods from stochastic error models; • apply fully data-driven models for the choice of regularisation parameters and evaluate these for concrete problems; • model identification problems in natural sciences and technology as inverse problems of partial differential equations where the unknown is e. g. a coefficient, an initial or a boundary condition or the shape of a region; • analyse the uniqueness and conditional stability of inverse problems of partial differential equations; • deduce sampling and testing methods for the solution of inverse problems of partial differential equations and analyse the convergence of such methods; • formulate mathematical models of medical imaging like computer tomography (CT) or magnetic resonance tomography (MRT) and know the basic characteristics of corresponding operators. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Inverse problems" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:**	3 C

Participation in the advanced seminar	

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Inverse problems"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4531
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4932: Advanced seminar on approximation methods	3 C 2 WLH

Learning outcome, core skills:	Workload:
Learning outcome: The successful completion of modules of the cycle "Approximation methods" enables students to learn methods, concepts, theories and applications in the area of "Approximation methods", so the approximation of one- and multidimensional functions as well as for the analysis and approximation of discrete signals and images. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of approximation problems in suitable finite- and infinite-dimensional vector spaces; • can confidently handle models for the approximation of one- and multidimensional functions in Banach and Hilbert spaces; • know and use parts of classical approximation theory, e. g. Jackson and Bernstein theorems for the approximation quality for trigonometrical polynomials, approximation in translationally invariant spaces; polynomial reductions and Strang-Fix conditions; • acquire knowledge of continuous and discrete approximation problems and their corresponding solution strategies both in the one- and multidimensional case; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods for the efficient solution of the approximation problems on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear approximation methods for multidimensional data; • are informed about current developments of efficient data approximation and data analysis; • adapt solution strategies for the data approximation using special structural characteristics of the approximation problem that should be solved. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Approximation methods" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) Examination prerequisites:	3 C

Participation in the advanced seminar	

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Approximation methods"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4532
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4933: Advanced seminar on numerical methods of partial differential equations**	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Numerics of partial differential equations" enables students to learn methods, concepts, theories and applications in the area of "Numerics of partial differential equations". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with the theory of linear partial differential equations, e. g. questions of classification as well as existence, uniqueness and regularity of the solution;
- know the basics of the theory of linear integral equations;
- are familiar with basic methods for the numerical solution of linear partial differential equations with finite difference methods (FDM), finite element methods (FEM) as well as boundary element methods (BEM);
- analyse stability, consistence and convergence of FDM, FEM and BEM for linear problems;
- apply methods for adaptive lattice refinement on the basis of a posteriori error approximations;
- know methods for the solution of larger systems of linear equations and their preconditioners and parallelisation;
- apply methods for the solution of larger systems of linear and stiff ordinary differential equations and are familiar with the problem of differential algebraic problems;
- apply available software for the solution of partial differential equations and evaluate the results sceptically;
- evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time;
- acquire advanced knowledge in the theory as well as development and application of numerical solution strategies in a special area of partial differential equations, e. g. in variation problems with constraints, singularly perturbed problems or of integral equations;
- know propositions about the theory of non-linear partial differential equations of monotone and maximally monotone type as well as suitable iterative solution methods.

Core skills:

After having successfully completed the module, students will be able to

- present a mathematical topic of current research interest in the area "Numerics of partial differential equations" in a talk;
- conduct scholarly debates with reference to current research.

Workload:

Attendance time:

28 h

Self-study time:

62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Numerical methods of partial differential equations"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4533
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen Module M.Mat.4934: Advanced seminar on optimisation	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Optimisation" enables students to learn methods, concepts, theories and applications in the area of "Optimisation", so the discrete and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • identify optimisation problems in application-oriented problems and formulate these as mathematical programmes; • evaluate the existence and uniqueness of the solution of an optimisation problem; • identify structural characteristics of an optimisation problem, amongst others the existence of a finite candidate set, the structure of the underlying level set; • know which special characteristics of the target function and the constraints (like (virtual) convexity, dc functions) for the development of solution strategies can be utilised; • analyse the complexity of an optimisation problem; • classify a mathematical programme in a class of optimisation problems and know current solution strategies for it; • develop optimisation methods and adapt general methods to special problems; • deduce upper and lower bounds for optimisation problems and understand their meaning; • understand the geometrical structure of an optimisation problem and apply it for solution strategies; • distinguish between proper solution methods, approximation methods with quality guarantee and heuristics and evaluate different methods on the basis of the quality of the found solutions and their computing times; • acquire advanced knowledge in the development of solution strategies on the basis of a special area of optimisation, e. g. integer optimisation, optimisation of networks or convex optimisation; • acquire advanced knowledge for the solution of special optimisation problems of an application-oriented area, e. g. traffic planning or location planning; • handle advanced optimisation problems, like e. g. optimisation problems with uncertainty or multi-criteria optimisation problems. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Optimisation" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Optimisation"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4534
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4937: Advanced seminar on variational analysis**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Variational analysis" enables students to learn methods, concepts, theories and applications in variational analysis and continuous optimisation. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • understand basic concepts of convex and variational analysis for finite- and infinite-dimensional problems; • master the characteristics of convexity and other concepts of the regularity of sets and functions to evaluate the existence and regularity of the solutions of variational problems; • understand basic concepts of the convergence of sets and continuity of set-valued functions; • understand basic concepts of variational geometry; • calculate and use generalised derivations (subderivatives and subgradients) of non-smooth functions; • understand the different concepts of regularity of set-valued functions and their effects on the calculation rules for subderivatives of non-convex functionals; • analyse constrained and parametric optimisation problems with the help of duality theory; • calculate and use the Legendre-Fenchel transformation and infimal convulutions; • formulate optimality criteria for continuous optimisation problems with tools of convex and variational analysis; • apply tools of convex and variational analysis to solve generalised inclusions that e. g. originate from first-order optimality criteria; • understand the connection between convex functions and monotone operators; • examine the convergence of fixed point iterations with the help of the theory of monotone operators; • deduce methods for the solution of smooth and non-smooth continuous constrained optimisation problems and analyse their convergence; • apply numerical methods for the solution of smooth and non-smooth continuous constrained programs to current problems; • model application problems with variational inequations, analyse their characteristics and are familiar with numerical methods for the solution of variational inequations; • know applications of control theory and apply methods of dynamic programming; • use tools of variational analysis in image processing and with inverse problems; • know basic concepts and methods of stochastic optimisation. **Core skills:**	**Workload:** Attendance time: 28 h Self-study time: 62 h

After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Variational analysis" in a talk; • conduct scholarly debates with reference to current research.	

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Variational analysis"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4537
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4938: Advanced seminar on image and geometry processing**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Image and geometry processing" enables students to learn and apply methods, concepts, theories and applications in the area of "Image and geometry processing", so the digital image and geometry processing. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the modelling of problems of image and geometry processing in suitable finite- and infinite-dimensional vector spaces; • learn basic methods for the analysis of one- and multidimensional functions in Banach and Hilbert spaces; • learn basic mathematical concepts and methods that are used in image processing, like Fourier and Wavelet transform; • learn basic mathematical concepts and methods that play a central role in geometry processing, like curvature of curves and surfaces; • acquire knowledge about continuous and discrete problems of image data analysis and their corresponding solution strategies; • know basic concepts and methods of topology; • are familiar with visualisation software; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • know which special characteristics of an image or of a geometry can be extracted and worked on with which methods; • evaluate different numerical methods for the efficient analysis of multidimensional data on the basis of the quality of the solutions, the complexity and their computing time; • acquire advanced knowledge about linear and non-linear methods for the geometrical and topological analysis of multidimensional data; • are informed about current developments of efficient geometrical and topological data analysis; • adapt solution strategies for the data analysis using special structural characteristics of the given multidimensional data. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Image and geometry processing" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Image and geometry processing"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4538
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4939: Advanced seminar on scientific computing / applied mathematics**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Scientific computing / applied mathematics" enables students to learn and apply methods, concepts, theories and applications in the area of "Scientific computing / applied mathematics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a practical course in scientific computing or a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the theory of basic mathematical models of the corresponding subject area, especially about the existence and uniqueness of solutions; • know basic methods for the numerical solution of these models; • analyse stability, convergence and efficiency of numerical solution strategies; • apply available software for the solution of the corresponding numerical methods and evaluate the results sceptically; • evaluate different numerical methods on the basis of the quality of the solutions, the complexity and their computing time; • are informed about current developments of scientific computing, like e. g. GPU computing and use available soft- and hardware; • use methods of scientific computing for solving application problems, like e. g. of natural and business sciences. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Scientific computing / applied mathematics" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Scientific computing / applied mathematics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4539
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4941: Advanced seminar on applied and mathematical stochastics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Applied and mathematical stochastics" enables students to understand and apply a broad range of problems, theories, modelling and proof techniques of stochastics. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued: Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • are familiar with substantial concepts and approaches of probability modelling and inferential statistics; • know basic characteristics of stochastic processes as well as conditions for their existence and uniqueness; • have a pool of different stochastic processes in time and space at their disposal and characterise those, differentiate them and quote examples; • understand and identify basic characteristics of invariance of stochastic processes like stationary processes and isotropy; • analyse the convergence characteristic of stochastic processes; • analyse regularity characteristics of the paths of stochastic processes; • adequately model temporal and spatial phenomena in natural and economic sciences as stochastic processes, if necessary with unknown parameters; • analyse probabilistic and statistic models regarding their typical characteristics, estimate unknown parameters and make predictions for their paths on areas not observed / at times not observed; • discuss and compare different modelling approaches and evaluate the reliability of parameter estimates and predictions sceptically. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Applied and mathematical stochastics" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Applied and mathematical stochastics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4541
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Numerical and Applied Mathematics

Georg-August-Universität Göttingen **Module M.Mat.4942: Advanced seminar on stochastic processes**	3 C 2 WLH

Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Stochastic processes" enables students to learn and apply methods, concepts, theories and proof techniques in the area of "Stochastic processes" and use these for the modelling of stochastic systems. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with advanced concepts of probability theory established on measure theory and apply them independently; • know basic characteristics as well as existence and uniqueness results for stochastic processes and formulate suitable probability spaces; • understand the relevance of the concepts of filtration, conditional expectation and stopping time for the theory of stochastic processes; • know fundamental classes of stochastic processes (like e. g. Poisson processes, Brownian motions, Levy processes, stationary processes, multivariate and spatial processes as well as branching processes) and construct and characterise these processes; • analyse regularity characteristics of the paths of stochastic processes; • construct Markov chains with discrete and general state spaces in discrete and continuous time, classify their states and analyse their characteristics; • are familiar with the theory of general Markov processes and characterise and analyse these with the use of generators, semigroups, martingale problems and Dirichlet forms; • analyse martingales in discrete and continuous time using the corresponding martingale theory, especially using martingale equations, martingale convergence theorems, martingale stopping theorems and martingale representation theorems; • formulate stochastic integrals as well as stochastic differential equations with the use of the Ito calculus and analyse their characteristics; • are familiar with stochastic concepts in general state spaces as well as with the topologies, metrics and convergence theorems relevant for stochastic processes; • know fundamental convergence theorems for stochastic processes and generalise these; • model stochastic systems from different application areas in natural sciences and technology with the aid of suitable stochastic processes; • analyse models in mathematical economics and finance and understand evaluation methods for financial products. **Core skills:** After having successfully completed the module, students will be able to	**Workload:** Attendance time: 28 h Self-study time: 62 h

- present a mathematical topic of current research interest in the area "Stochastic processes" in a talk;
- conduct scholarly debates with reference to current research.

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Stochastic processes"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4542
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4943: Advanced seminar on stochastic methods in economathematics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Stochastic methods of economathematics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • master problems, basic concepts and stochastic methods of economathematics; • understand stochastic connections; • understand references to other mathematical areas; • get to know possible applications in theory and practice; • gain insight into the connection of mathematics and economic sciences. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Stochastic methods in economathematics" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Stochastic methods in economathematics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4543
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4944: Advanced seminar on mathematical statistics**	3 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The successful completion of modules of the cycle "Mathematical statistics" enables students to learn methods, concepts, theories and applications in the area of "Mathematical statistics". During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Bachelor's or Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with the most important methods of mathematical statistics like estimates, testing, confidence propositions and classification and use them in simple models of mathematical statistics; • evaluate statistical methods mathematically precisely via suitable risk and loss concepts; • analyse optimality characteristics of statistical estimate methods via lower and upper bounds; • analyse the error rates of statistical testing and classification methods based on the Neyman Pearson theory; • are familiar with basic statistical distribution models that base on the theory of exponential indexed families; • know different techniques to obtain lower and upper risk bounds in these models; • are confident in modelling typical data structures of regression; • analyse practical statistical problems in a mathematically accurate way with the techniques learned on the one hand and via computer simulations on the other hand; • are able to mathematically analyse resampling methods and apply them purposively; • are familiar with advanced tools of non-parametric statistics and empirical process theory; • independently become acquainted with a current topic of mathematical statistics; • evaluate complex statistical methods and enhance them in a problem-oriented way. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Mathematical statistics" in a talk; • conduct scholarly debates with reference to current research.	Attendance time: 28 h Self-study time: 62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes)	3 C

Examination prerequisites: Participation in the advanced seminar	

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Mathematical statistics"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4544
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.Mat.4945: Advanced seminar on statistical modelling and inference**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The successful completion of modules of the cycle "Statistical modelling and inference" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students • are familiar with basic principles of statistical parametric and non-parametric modelling for a broad spectrum of data types; • know Bayesian and common concepts for modelling and interference as well as their connection; • master most important methods for model validation and model choice and know their theoretical characteristics; • develop and validate numerical methods for model estimation and interference; • deduce asymptotic characteristics of well-known statistical models; • use modelling and interference for complex live data. **Core skills:** After having successfully completed the module, students will be able to • present a mathematical topic of current research interest in the area "Statistical modelling and inference" in a talk; • conduct scholarly debates with reference to current research.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Advanced seminar	2 WLH
Examination: Oral Presentation (approx. 75 minutes) **Examination prerequisites:** Participation in the advanced seminar	3 C
Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Statistical modelling and inference"	

Admission requirements: none	**Recommended previous knowledge:** M.Mat.4545
Language: English	**Person responsible for module:** Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
Instructor: Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen Module M.Mat.4946: Advanced seminar on multivariate statistics	3 C 2 WLH

Learning outcome, core skills:

Learning outcome:

The successful completion of modules of the cycle "Multivariate statistics" enables students to learn methods, concepts, theories and applications in this area. During the course of the cycle students will be successively introduced to current research topics and able to carry out independent contributions to research (e. g. within the scope of a Master's thesis). Depending on the current course offer the following content-related competencies may be pursued. Students

- are familiar with basic principles of statistic modelling as well as estimate and test theory;
- understand the basics of multivariate statistics;
- know the main features of the theory of empirical processes;
- master basic methods of multivariate extreme value theory;
- understand the relevance of dependencies in multivariate statistics like e. g. modelled by copulas;
- are familiar with basic principles of modelling, estimate and test methods for data on non-standard spaces;
- are especially familiar with concepts and methods of directional analysis and statistical shape analysis;
- apply statistical methods for data on manifolds and stratified spaces;
- are familiar with the relevant statistics of random matrices as well as their eigenvalues and eigenvectors for this purpose.

Core skills:

After having successfully completed the module, students will be able to

- present a mathematical topic of current research interest in the area "Multivariate statistics" in a talk;
- conduct scholarly debates with reference to current research.

Workload:

Attendance time:

28 h

Self-study time:

62 h

Course: Advanced seminar	2 WLH

Examination: Oral Presentation (approx. 75 minutes) Examination prerequisites: Participation in the advanced seminar	3 C

Examination requirements: Autonomous permeation and presentation of complex mathematical issues of current research literature in the area "Multivariate statistics"	

Admission requirements: none	Recommended previous knowledge: M.Mat.4546
Language:	**Person responsible for module:**

English	Programme coordinator
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 4
Maximum number of students: not limited	

Additional notes and regulations: **Instructor:** Lecturers at the Institute of Mathematical Stochastics

Georg-August-Universität Göttingen **Module M.OAW.MS.008: Case Studies: History of Modern China**	9 C 2 WLH

Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese history. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h

Course: History of Modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C

Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Prof. Dr. Dominic Sachsenmaier
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.009: Case Studies: Philosophy of Modern China**	9 C 2 WLH
Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese philosophy. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h
Course: Philosophy of Modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C
Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Prof. Dr. Dominic Sachsenmaier
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.01: State of the Field: History, Philosophy, Religion**	12 C 4 WLH

Learning outcome, core skills: This seminar makes the state of research on the history, philosophy and religion of modern China accessible to students. By reading recent research publications, students become familiar with the key issues of the subject, discuss them comparatively and deal critically with relevant theories and methods. They delve deeper into a specific topic by a) creating a presentation and b) writing a term paper. In an accompanying reading course, students read, explore terminologically, contextualize academically and translate excerpts from relevant Chinese secondary literature.	**Workload:** Attendance time: 56 h Self-study time: 304 h

Courses:	
1. State of the Field (Seminar)	2 WLH
2. Modern Literary Language Advanced Course I (Exercise)	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.) **Examination requirements:** The academic translation of a relevant Chinese secondary source is integrated into the term paper.	12 C

Examination requirements: Knowledge of both the Western and Chinese state of research on a topic area as well as an understanding of key issues and their methodological and theoretical implications and challenges. Critical analysis of dominant theoretical assumptions about China and consideration as to what extent these are justified or need to be adapted. Ability to read, analyze and translate Chinese academic literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.010: Case Studies: Religion of Modern China**	9 C 2 WLH
Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese religion. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h
Course: Religion of modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C
Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Prof. Dr. Dominic Sachsenmaier
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.011: Case Studies: Politics of Modern China**	9 C 2 WLH

Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese politics. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h

Course: Politics of modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C

Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Carolin Kautz
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.012: Case Studies: Society of Modern China**	9 C 2 WLH

Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese society. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h

Course: Society of modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C

Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Sarah Eaton Dr. Armin Müller
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.013: Case Studies: Law of Modern China**	9 C 2 WLH
Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese law. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h
Course: Law of modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C
Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Carolin Kautz
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.014: Case Studies: Economy of Modern China**	9 C 2 WLH

Learning outcome, core skills: The students enlarge on one specific topic of modern Chinese economy. By thoroughly reading and discussing Western and Chinese secondary literature students develop a research question and, on the basis of this, a research project (the students select adequate methods and theories; critically transpose scientific theories developed when studying Western phenomena to Non-Western areas of research; identify relevant materials and sources and make them accessible in publications and archives; set up a realistic work plan). The students enlarge on one specific topic by a) preparing a presentation and b) writing a term paper.	**Workload:** Attendance time: 28 h Self-study time: 242 h

Course: Economy of modern China (Seminar)	2 WLH
Examination: Presentation (ca. 30. min.) and term paper (max. 10,000 words) **Examination prerequisites:** regular and active participation	9 C

Examination requirements: Students know the Chinese and Western state of the art on a specific and circumscribed topic of research and how to apply methodical and theoretical skills to an aspect of this topic and to use Chinese primary materials and sources in this. They develop a research project organizationally, methodologically and theoretically, and have to read the compulsory readings.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Sarah Eaton Dr. Armin Müller
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.018: Modern Written Language II**	6 C 2 WLH
Learning outcome, core skills: In this module skills in modern Chinese written language are enlarged and consolidated. In particular, skills are trained in adequately giving an account of written Chinese and in written communication.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Modern written language II (Exercise)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** regular and active participation **Examination requirements:** Written exam on the comprehension of written texts.	6 C
Examination requirements: The students have to be able to understand sophisticated and demanding academic texts. They have to give an account in colloquial Chinese and to respond to them (in correspondence etc.)	

Admission requirements: M.OAW.MS.020	**Recommended previous knowledge:** none
Language: Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module M.OAW.MS.019: Colloquium**	12 C 2 WLH

Learning outcome, core skills: In this module students are trained in developing their own research projects particularly with regard to research approach, research question and methodological and theoretical concepts to be used for their project. They get the opportunity to present their research project underlying their MA thesis and can thereby profit from the respective discussions and comments, helping them with their further research. All students have to read relevant academic literature on the topics of the different presentations and research projects as well as on the relevant theoretical approaches.	**Workload:** Attendance time: 28 h Self-study time: 332 h

Course: Master colloquium (Seminar)	2 WLH
Examination: Oral Presentation (approx. 30 minutes), not graded **Examination prerequisites:** regular participation, written exposé (max. 5000 words) **Examination requirements:** Students have draft an exposé of the planned MA thesis together with their supervisor and present topic, research approach and progress of their research to their fellow students as well as respond to critical questions.	12 C

Examination requirements: Students have draft an exposé of the planned MA thesis together with their supervisor and present topic, research approach and progress of their research to their fellow students as well as respond to critical questions.	

Admission requirements: Successful completion of at least one of the following modules: M.OAW.MS.001 to M.OAW.MS.014 (see remark)	**Recommended previous knowledge:** None
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Prof. Dr. Dominic Sachsenmaier, Prof. Dr. Sarah Eaton
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Additional notes and regulations: Students studying Modern Sinology totaling 78 C have to have completed at least two of the modules mentioned. Students studying Modern Sinology totaling 42 C have to have completed at least one of the modules mentioned.

Georg-August-Universität Göttingen Module M.OAW.MS.01a: State of research: history, philosophy, religion	12 C 2 WLH
Learning outcome, core skills: This seminar makes the state of research on the history, philosophy and religion of modern China accessible to students. By reading recent research publications, students become familiar with the key issues of the subject, discuss them comparatively and deal critically with relevant theories and methods. They delve deeper into a specific topic by a) creating a presentation and b) writing a term paper. In addition, the students conduct independent reading geared towards the organization of relevant theoretical work.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: State of the Field Independent reading of additional, relevant secondary literature, preferably of a theoretical nature.	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.)	12 C
Examination requirements: Knowledge of the Western state of research on a topic area as well as an understanding of key issues and their methodological and theoretical implications and challenges. Critical analysis of dominant theoretical assumptions about China and consideration as to what extent these are justified or need to be adapted.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.02: State of Research: Politics, Society, Law**	12 C 4 WLH
Learning outcome, core skills: This seminar makes the state of research on the politics, society and law of modern China accessible to students. By reading recent research publications, students become familiar with the key issues of the subject, discuss them comparatively and deal critically with relevant theories and methods. They delve deeper into a specific topic by a) creating a presentation and b) writing a term paper. In an accompanying reading course, students read, explore terminologically, contextualize academically and translate excerpts from relevant Chinese secondary literature.	**Workload:** Attendance time: 56 h Self-study time: 304 h
Courses: **1. State of the Field**	 2 WLH
2. Modern Literary Language Advanced Course I (Exercise)	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.) **Examination requirements:** The academic translation of a relevant Chinese secondary source is integrated into the term paper.	12 C
Examination requirements: Knowledge of both the Western and Chinese state of research on a topic area as well as an understanding of key issues and their methodological and theoretical implications and challenges. Critical analysis of dominant theoretical assumptions about China and consideration as to what extent these are justified or need to be adapted. Ability to read, analyze and translate Chinese academic literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Sarah Eaton
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module M.OAW.MS.020: Modern Chinese VI**	6 C 8 WLH
Learning outcome, core skills: After completing this module, students can follow and understand Chinese-language lectures, including technical discussions in their field of specialization, and participate in discussions conducted in standard Chinese relating to issues such as work and current events. They can understand newscasts and current affairs programs (TV, radio), as well as feature films, provided they are in the standard language. Students have sufficient language skills to express themselves clearly on general topics and share their personal views. They need not spend too much time searching for the right word, use complex sentence structures and show a fairly good command of grammar. They no longer make mistakes that lead to misunderstandings.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Speaking and Listening (Exercise)	4 WLH
2. Reading and Writing (Exercise)	4 WLH
Examination: Language proficiency test: written part (text editing, grammar, vocabulary and translation 120 min.) and oral part (speaking and listening; approx. 20 min.) **Examination requirements:**	6 C

Examination requirements: The students have to prove their language skills in listening, speaking, reading and writing in intercultural contexts of oral and written communication (receptive skills on level B2.2 of the Common European Framework of Reference for Languages).	

Admission requirements: B.A. degree with a level of language skills equivalent to the level achieved in the B.A. “Moderne Sinologie” or “Chinesisch als Fremdsprache” of the University of Göttingen	**Recommended previous knowledge:** none
Language: Chinesisch, German	**Person responsible for module:** Lingling Ni
Course frequency: each winter semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Additional notes and regulations:

The teaching language in this module is Chinese as the module is aimed at advancing and improving language skills. Translations will be done from Chinese into English by students of the study program "MA Modern Sinology" and into German by students of the study program "Master of Education Chinesisch als Fremdsprache".

Georg-August-Universität Göttingen **Module M.OAW.MS.021: Modern Chinese VII**	6 C 4 WLH

Learning outcome, core skills: After completing this module students are able to follow and comprehend talks and presentations in Chinese, understand discussions in their area of specialization and take part in discussions in standard Chinese on topics such as labour relations and current events . They can understand news broadcastings and current reporting (TV and radio) as well as films in standard Chinese. The language skills of the students are sufficient to discuss general topics and express their opinions They do not spend time searching for the right word, use complex sentence structures and show a good command of grammar. They no longer make mistakes that lead to misunderstandings.	**Workload:** Attendance time: 112 h Self-study time: 68 h

Courses:	
1. Speaking and Listening (Exercise)	2 WLH
2. Reading and Writing (Exercise)	2 WLH
Examination: Language proficiency test: written part (text editing, grammar, vocabulary and translation 120 min.) and oral part (speaking and listening; approx. 20 min.)	6 C

Examination requirements: The students have to prove their language skills in listening, speaking, reading and writing in intercultural contexts of oral and written communication (receptive skills on level C1.1 of the Common European Framework of Reference for Languages).	

Admission requirements: M.OAW.MS.020	**Recommended previous knowledge:** none
Language: Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Ni Lingling
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Module M.OAW.MS.02a: State of Research: Politics, Society, Law	12 C 2 WLH
Learning outcome, core skills: This seminar makes the state of research on the politics, society and law of modern China accessible to students. By reading recent research publications, students become familiar with the key issues of the subject, discuss them comparatively and deal critically with relevant theories and methods. They delve deeper into a specific topic by a) creating a presentation and b) writing a term paper. In addition, the students conduct independent reading geared towards the organization of relevant theoretical work.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: State of the Field Independent reading of additional, relevant secondary literature, preferably of a theoretical nature.	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.) **Examination requirements:** The academic translation of a relevant Chinese secondary source is integrated into the term paper.	12 C
Examination requirements: Knowledge of the Western state of research on a topic area as well as an understanding of key issues and their methodological and theoretical implications and challenges. Critical analysis of dominant theoretical assumptions about China and consideration as to what extent these are justified or need to be adapted. Reading the required literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Sarah Eaton
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Module M.OAW.MS.03: Modern Chinese VI	6 C 8 WLH
Learning outcome, core skills: After completing this module, students can follow and understand Chinese-language lectures, including technical discussions in their field of specialization, and participate in discussions conducted in standard Chinese relating to issues such as work and current events. They can understand newscasts and current affairs programs (TV, radio), as well as feature films, provided they are in the standard language. Students have sufficient language skills to express themselves clearly on general topics and share their personal views. They need not spend too much time searching for the right word, use complex sentence structures and show a fairly good command of grammar. They no longer make mistakes that lead to misunderstandings.	**Workload:** Attendance time: 112 h Self-study time: 68 h
Courses: **1. Speaking and Listening** (Exercise) **2. Reading and Writing** (Exercise)	 4 WLH 4 WLH
Examination: Language proficiency test: written part (text editing, grammar, vocabulary and translation 120 min.) and oral part (speaking and listening; approx. 20 min.)	6 C
Examination requirements: Proof of situational linguistic competence in intercultural contexts using the four language skills listening, speaking, reading and writing, i.e. demonstration of receptive skills sufficient to appropriately deal with oral and written communication situations at the level B2.2 of the Common European Framework of Reference.	

Admission requirements: Bachelor's degree that reaches a level comparable to the Göttingen BA in Modern Sinology or Chinese as a Foreign Language.	**Recommended previous knowledge:** none
Language: Chinesisch	**Person responsible for module:** Lingling Ni
Course frequency: each winter semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Additional notes and regulations:

The main language of instruction of this module is Chinese, beacuase the module is focused on four language skills. For MA students the translation part is offered in Chinese/English, for the M.Ed. students the translation part is offered in Chinese/German.

Georg-August-Universität Göttingen **Module M.OAW.MS.04: Advanced Course on the Theories and Methods of Reseach in the Humanities and Social Sciences**	6 C 2 WLH

Learning outcome, core skills: In this seminar, methods and theories relevant to Modern Sinology will be developed and discussed in detail on the basis of pertinent theoretical essays and oral presentations. Theoretical reflection in the form of an essay on the benefits of the theories and methods discussed for a research topic (to be selected by the student) related to modern China research.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Advanced Course on the Theories and Methods of Research in the Humanities and Social Sciences (Seminar)	2 WLH
Examination: Essay (max. 8000 words) **Examination prerequisites:** Regular attendance, keynote presentation (approx. 20 min.)	6 C

Examination requirements: Familiarity with selected methodological and theoretical debates in cultural studies, critical reflection on the general applicability of the same in Sinology and the ability to demonstrate (and, where appropriate, problematize) this with concrete Sinological research projects and subjects. Reading the required literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider Eaton, Sarah, Prof. Dr.
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen Module M.OAW.MS.05: Case Studies: History, Philosophy, Religion	12 C 4 WLH
Learning outcome, core skills: This seminar is designed to deepen students' knowledge of a special topic in the fields of history, philosophy and religion of modern China. Through intensive reading and discussion of Western and Chinese secondary literature, course participants practice developing and planning a research project (selection of appropriate methods and theories, identifying relevant sources and their concrete development in publications or archives, creating a realistic work plan). Students deal with part of the topic in a presentation, which in turn serves to help them to prepare the term paper. In an accompanying reading course, students read exemplary, relevant Chinese primary literature, develop it terminologically, contextualize it historically and translate excerpts.	**Workload:** Attendance time: 56 h Self-study time: 304 h
Courses:	
1. State of the Field (Seminar)	2 WLH
2. Modern Literary Language Advanced Course II (Exercise)	2 WLH
Examination: Term Paper (max. 20000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.) **Examination requirements:** The academic translation of a relevant Chinese primary source is integrated into the term paper.	12 C
Examination requirements: Knowledge of both the Western and Chinese state of research on a specific, isolated topic. Application of the methodological and theoretical knowledge and skills acquired in the seminar on the state of research to one aspect of this topic with the assistance of Chinese-language primary sources. Practice in the organizational and methodical-theoretical steps required to plan a concrete research project. Reading the required literature.	

Admission requirements: M.OAW.MS.01	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen Module M.OAW.MS.05a: Case studies: History, Philosophy, Religion	12 C 2 WLH
Learning outcome, core skills: This seminar is designed to deepen students' knowledge of a special topic in the fields of history, philosophy and religion of modern China. Through intensive reading and discussion of Western and Chinese secondary literature, course participants practice developing and planning a research project (selection of appropriate methods and theories, identifying relevant sources and their concrete development in publications or archives, creating a realistic work plan). Students deal with part of the topic in a presentation, which in turn serves to help them to prepare the term paper.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: State of the Field + Independent reading of additional, relevant secondary literature, preferably of a theoretical nature.	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.)	9 C
Examination requirements: Knowledge of the Western state of research on a specific, isolated topic. Application of the methodological and theoretical knowledge and skills acquired in the seminar on the state of research to one aspect of the topic. Practice in the organizational and methodical-theoretical steps required to plan a concrete research project.	

Admission requirements: M.OAW.MS.01a	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen Module M.OAW.MS.06a: Case studies: Politics, Society, Law	12 C 2 WLH
Learning outcome, core skills: This seminar is designed to deepen students' knowledge of a special topic in the fields of politics, society and law of modern China. Through intensive reading and discussion of Western and Chinese secondary literature, course participants practice developing and planning a research project (selection of appropriate methods and theories, identifying relevant sources and their concrete development in publications or archives, creating a realistic work plan). Students deal with part of the topic in a presentation, which in turn serves to help them to prepare the term paper.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: State of the Field + Independent reading of additional, relevant secondary literature, preferably of a theoretical nature.	2 WLH
Examination: Term Paper (max. 15000 words) **Examination prerequisites:** Regular attendance, presentation (approx. 30 min.)	9 C
Examination requirements: Knowledge of the Western state of research on a specific, isolated topic. Application of the methodological and theoretical knowledge and skills acquired in the seminar on the state of research to one aspect of the topic. Practice in the organizational and methodical-theoretical steps required to plan a concrete research project. Reading the required literature.	

Admission requirements: M.OAW.MS.02a	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module M.OAW.MS.07: Research Project**	12 C 2 WLH
Learning outcome, core skills: In this module, students receive guidance in applying the skills acquired in the modules M.OAW.MS.05 and 06 (project planning: selection of appropriate methods and theories, identifying relevant sources and their concrete development in publications or archives, creating a realistic work plan) to the secondary and primary sources relevant to their Master's thesis while at the same time improving their ability to read sophisticated, academic written language. This module can be completed in Göttingen or in China.	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: Research project	2 WLH
Examination: Written exposé for the Master's Thesis (max. 5000 words.), not graded **Examination prerequisites:** Regular attendance	12 C
Examination requirements: Design of a research project by selecting appropriate methods and theories, identification and concrete development of relevant sources in publications or archives. Creation of a realistic work plan. Reading the required literature.	

Admission requirements: M.OAW.MS.01 or M.OAW.MS.02 and M.OAW.MS.05 or M.OAW.MS.06	**Recommended previous knowledge:** none
Language: Chinesisch, English	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.08: Thesis Preparation**	6 C 2 WLH

Learning outcome, core skills: In this seminar, students have the opportunity to present their Master's thesis in the circle of supervisors and peers and to benefit from the discussions and comments on the progress of their work. For each presentation, the other students must read accompanying literature on the topic of each Master's Thesis presented and on relevant theories.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Thesis Preparation (Seminar) (6 weeks, 4 hours)	2 WLH
Examination: Oral Report (approx. 30 minutes), not graded **Examination prerequisites:** Regular attendance **Examination requirements:** The topic, problem posed, theses and possibly even the first results of the Master's Thesis project should be presented.	6 C

Examination requirements: Based on the exposé of their planned Master's Thesis students created in the module M.OAW.MS.07, they must present their topic, research approach and research progress, and address their fellow students' critical questions.	

Admission requirements: M.OAW.MS.01 or M.OAW.MS.02 and M.OAW.MS.05 or M.OAW.MS.06	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.OAW.MS.09: Review**	6 C
Learning outcome, core skills: Students must submit a comparative review of two monographs closely thematically related to the term papers written in the modules M.OAW.MS.1a/M.OAW.MS.2a or M.OAW.MS.5a/M.OAW.MS.6a.	**Workload:** Attendance time: 0 h Self-study time: 180 h
Examination: Term Paper (max. 8000 words)	6 C
Examination requirements: Comparative review of two Western monographs on the state of research on the basis of relevant contextual information. The review consists of an analytical description (identifying the research question, the relevant state of research; the chosen theoretical approach, the methods used, related sources, the form of presentation and research results) and an assessment in terms of a) the implementation of the claims made by the author, and b) the contribution to the state of research. Finally, c) an evaluation must be performed as to what extent the examinee considers the selected theories and methods to be adequate, how the examinee would assess their application and implementation in the book to be discussed, and whether and why the examinee can agree with the research results achieved.	

Admission requirements: M.OAW.MS.1a oder M.OAW.MS.2a sowie M.OAW.MS.5a oder M.OAW.MS.6a	**Recommended previous knowledge:** none
Language: English, Chinesisch	**Person responsible for module:** Prof. Dr. Axel Schneider
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module M.Phy-AM.001: Active Galactic Nuclei**	6 C 2 WLH

Learning outcome, core skills: **Learning outcome:** Observational properties of active galaxies, taxonomy of AGN, continuum and emission line physics, structure and cinematics of the central region, supermassive black holes, unified models, environment, evolution of AGN. **Core skills:** After successful completion of the modul students should be able to describe and explain spectroscopy and physical properties of active galaxies.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Lecture with exercises	
Examination: Oral Exam (ca. 30 Min.)	6 C

Examination requirements: Classification, spectral properties and physics of the central region in active galaxies surrounding the central supermassive black hole, properties of the hostgalaxies, large scale environment, evolution of AGN.	

Admission requirements: Previous AstroMundus courses (1.+2. Sem.)	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Wolfram Kollatschny
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Phy-AM.002: Stellar structure and evolution**	6 C 2 WLH

Learning outcome, core skills:	**Workload:**
Learning outcome: The physics of stellar interiors and the evolution of stars belong to the fundamentals of astrophysics. The following topics will be studied in detail: Equations of stellar structure - Energy transport by diffusion of radiation, convection, and conduction - Equation of state, opacity and nuclear energy generation - Methods for the solution of the equations of stellar structure - Simple stellar models (polytropes) and their application - Stellar evolution: Pre - main sequence evolution, main sequence phase, post - main sequence evolution, final stages of stellar evolution.. **Core skills:** After successful completion of the modul students should be able to describe and explain the fundamentals of stellar structure and evolution, application of the concepts and results of the subject to other areas of astrophysics	Attendance time: 28 h Self-study time: 152 h

Course: Lecture	
Examination: Oral Exam (ca. 30 Min.) **Examination prerequisites:** Solution of exercises	6 C

Examination requirements:	
Knowledge of the physics of stellar structure and evolution, the mechanics and thermodynamics of stellar structure, the methods for the solution of the equations of stellar structure, the various stages of stellar evolution and their interpretation.	

Admission requirements: Previous AstroMundus courses (1.+2. Sem.)	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Wolfram Kollatschny
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Phy-AM.011: Computer simulation methods in statistical physics**	3 C 2 WLH
Learning outcome, core skills: **Learning outcome:** The use of computers to solve problems in statistical physics is well established, and extremely useful in cases where exact solutions are not available. In this course, the Monte Carlosimulation method will be presented, whose applications are widespread, and include the field of biology. Starting with the basic Metropolis algorithm for the Ising model, this course will gradually move on to consider more complex systems, and show how the Monte Carlo method can be used to extract thermodynamic limit properties with relative ease. **Core skills:** Implement state-of-the-art MC simulations	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Lecture	2 WLH
Examination: Oral Exam (ca. 30 Min.)	3 C
Examination requirements: The aim of the course is to present the Monte Carlo simulation method,with the focus of application on many-body problems as encountered in statistical physics.	

Admission requirements: Previous AstroMundus courses (1.+2. Sem.)	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Wolfram Kollatschny
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy-AM.012: Astrophysical Properties: From planets to cosmology**	12 C 8 WLH
Learning outcome, core skills: After successful completion of the modul the students should have competence in different fields of observational as well as theoretical astrophysics. The topics of these lectures range from the nearby universe covering the Sun, Space Weather, helioseismology and planets up to more distant stars. Another subject is the physics and evolution of galaxies including their central supermassive Black Holes. Finally, aspects of the evolution of the universe (cosmology) will be addressed.	**Workload:** Attendance time: 112 h Self-study time: 248 h
Course: students choose 4 courses of the following contents *Contents*: - Cosmology, Early Universe, String theory - Galaxies, Supermassive Black Holes, Interstellar Medium - Stars, Planets - Solar Physics, (Helio)seismology, Space Weather - Observational Astrophysics - Numerical Experiments in Astrophysics	
Examination: Oral examination (approx. 60 minutes) **Examination requirements:** The basic physical principals that have been taught in the individual lectures have to be understood in the context of the astrophysical relevance. This includes competence in numerical methods for the lecture on numerical experiments in astrophysics.	12 C

Admission requirements: 1st year AstroMundus courses	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Wolfram Kollatschny
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Phy.1401: Advanced Lab Course I**	6 C 6 WLH
Learning outcome, core skills: After successful completion of the module, students should - familiarise oneself independently into complex issues - perform experimental tasks under guidance in teamwork - write scientific protocols in terms of good scientific practice	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Praktikum	
Examination: 4 reports (max. 25 pages) **Examination prerequisites:** 4 successful performed experiments. **Examination requirements:** Advanced experimental methods for solving physical problems.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Phy.1402: Advanced Lab Course II**	6 C 6 WLH
Learning outcome, core skills: After successful completion of the module, students should - familiarise oneself independently into complex issues - perform experimental tasks under guidance in teamwork - write scientific protocols in terms of good scientific practice	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Advanced Lab Course II	
Examination: 4 reports (max. 25 pages) **Examination prerequisites:** 4 successfull performed experiments **Examination requirements:** Advanced experimental methods for solving physical problems.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 2
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Phy.1403: Internship**	6 C 6 WLH
Learning outcome, core skills: After successful completion of the module, students should familiarise oneself independently in complex issues and perform tasks under guidance in team work. The students should be able to present the obtained results in a talk or as a poster.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Internship	
Examination: Talk (approx. 30 min.) or Poster **Examination prerequisites:** Internship **Examination requirements:** Advanced methods for solving physical problems in the area of the chosen focus.	6 C

Admission requirements: This module can be selected only on the recommendation of a lecturer.	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 2

Georg-August-Universität Göttingen **Module M.Phy.405: Research Lab Course in Astro- and Geophysics**	18 C

Learning outcome, core skills: **Competencies:** Students should be able to familiarise oneself independently in a current scientific research project, perform it successfully and present the results to a professional audience.	**Workload:** Attendance time: 0 h Self-study time: 540 h

Course: Research Lab Course in Astro- and Geophysics	

Examination: Lecture, (2 weeks preparation time) (approx. 30 minutes) **Examination requirements:** Methods for in-depth familiarisation in a scientific field of work, critical review of literature, scientific presentation, good scientific practice.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Alle Dean of Studies of the Faculty of Physics
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.406: Research Lab Course in Biophysics and Physics of Complex Systems**	18 C
Learning outcome, core skills: **Competencies:** Students should be able to familiarise oneself independently in a current scientific research project, perform it successfully and present the results to a professional audience.	**Workload:** Attendance time: 0 h Self-study time: 540 h
Course: Research Lab Course in Biophysics and Physics of Complex Systems	
Examination: Lecture, (2 weeks preparation time) (approx. 30 minutes) **Examination requirements:** Methods for in-depth familiarisation in a scientific field of work, critical review of literature, scientific presentation, good scientific practice.	18 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Alle Dean of Studies of the Faculty of Physics
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.407: Research Lab Course in Solid State/Materials Physics**	18 C

Learning outcome, core skills: **Competencies:** Students should be able to familiarise oneself independently in a current scientific research project, perform it successfully and present the results to a professional audience.	**Workload:** Attendance time: 0 h Self-study time: 540 h
Course: Research Lab Course in Solid State/Materials Physics	
Examination: Lecture, (2 weeks preparation time) (approx. 30 minutes) **Examination requirements:** Methods for in-depth familiarisation in a scientific field of work, critical review of literature, scientific presentation, good scientific practice.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.408: Research Lab Course in Particle Physics**	18 C
Learning outcome, core skills: Students should be able to familiarise oneself independently in a current scientific research project, perform it successfully and present the results to a professional audience.	**Workload:** Attendance time: 0 h Self-study time: 540 h
Course: Research Lab Course in Particle Physics	
Examination: Lecture, (2 weeks preparation time) (approx. 30 minutes) **Examination requirements:** Methods for in-depth familiarisation in a scientific field of work, critical review of literature, scientific presentation, good scientific practice.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen Module M.Phy.409: Research Seminar Astro-/Geophysics	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should present complex lines of reasoning and evaluate own and others' presentations in critical discussion.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Research Seminar Astro-/Geophysics	
Examination: Lecture, (4 weeks preparation time) (approx. 60 minutes) **Examination requirements:** Preparation of complex topics for presentation and scientific discussions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen Module M.Phy.410: Research Seminar Biophysics/Physics of Complex Systems	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should present complex lines of reasoning and evaluate own and others' presentations in critical discussion.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Research Seminar Biophysics/Physics of Complex Systems	
Examination: Lecture, (4 weeks preparation time) (approx. 60 minutes) **Examination prerequisites:** active partizipation **Examination requirements:** Preparation of complex topics for presentation and scientific discussions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen Module M.Phy.411: Research Seminar Solid State/Materials Physics	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should present complex lines of reasoning and evaluate own and others' presentations in critical discussion.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Research Seminar Solid State/Materials Physics	
Examination: Lecture, (4 weeks preparation time) (approx. 60 minutes) **Examination prerequisites:** active participation **Examination requirements:** Preparation of complex topics for presentation and scientific discussions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.412: Research Seminar Particle Physics**	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should present complex lines of reasoning and evaluate own and others' presentations in critical discussion.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Research Seminar Particle Physics	
Examination: Lecture, (4 weeks preparation time) (approx. 60 minutes) **Examination prerequisites:** active participation **Examination requirements:** Preparation of complex topics for presentation and scientific discussions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.413: General Seminar**	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should be able to develop the content of scientific publications (usually in English) independently and present it to a wide audience. They should be also able to evaluate it criticaly.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: General Seminar	
Examination: Lecture, (4 weeks preparation time) (approx. 60 minutes) **Examination prerequisites:** active participation **Examination requirements:** Use of presentation media, presentation of complex issues in front of expert and non-expert audiences, communication and discussion skills, critical awareness and expressiveness.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 150	

Additional notes and regulations:
We recomend to chose the seminar not of the own research focus.

Georg-August-Universität Göttingen **Module M.Phy.5002: Contemporary Physics**	4 C 2 WLH

Learning outcome, core skills: **Lernziele**: To understand cutting-edge research in 6 topics in physics by attending the physics colloquia. Introductory lectures will be provided to bridge the gap between students lectures and the scientific level of the colloquium. **Kompetenzen**: After successful completion of modul students should be able to... • independent learning; • independent analysis; • work in teams; • write scientific reports; • read scientifc literature; • extract the important research questions and results from the physics colloquia.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Contemporary Physics	2 WLH

Examination: written report (max. 5 pages) **Examination requirements:** Ability to combine the information given in the introductory lecture, the physics colloquium and current literature in 6 written reports on each of the colloquium topics.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Phy.5502: Numerical experiments in stellar astrophysics	3 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should have hands-on experience computing stellar models and solving oscillation eigenvalue problems.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Vorlesung (Lecture)	
Examination: Oral examination (approx. 30 minutes) **Examination prerequisites:** keine **Examination requirements:** • Use of numerical codes to model the internal structure and oscillations of stars. • Hands-on experience with the codes. • Computation of stellar models and their oscillation frequencies. • Experimenting with parameters and physical inputs.	3 C

Admission requirements: keine	**Recommended previous knowledge:** keine
Language: English	**Person responsible for module:** Prof. Dr. Laurent Gizon
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 2 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.551: Advanced Topics in Astro-/Geophysics I**	6 C 6 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of astrophysics and Geophysics.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Course (6 C) in the field of Astro- or Geophysics	
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in astro- or geophysics	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.552: Advanced Topics in Astro-/Geophysics II**	6 C 4 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of astrophysics and Geophysics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Advanced Topics in Astro-/Geophysics IIa	2 WLH
Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) or talk (approx. 30 Min.), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in astro- or geophysics	3 C
Course: Advanced Topics in Astro-/Geophysics IIb	2 WLH
Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) or talk (approx. 30 Min.), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in astro- or geophysics	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.556: Seminar Advanced Topics in Astro-/Geophysics**	4 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with the presentation of complex problems, scientific discussion as well as evaluation of contents of the presentations.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar Advanced Topics in Astro-/Geophysics I	
Examination: Lecture, 4 weeks preparation time (approx. 60 minutes) **Examination prerequisites:** active Participation **Examination requirements:** Advanced experimental techniques or theoretical models in astro- or geophysics	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Stefan Dreizler
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.5601: Seminar Computational Neuroscience/Neuro-informatics**	4 C 2 WLH
Learning outcome, core skills: After successful completion of the module, students should ... • have deepened their knowledge of computational neuroscience / neuroinformatics by an independent elaboration of a topic; • have learned methods of presentation of topics from computer science; • be able to deal with (English-language) literature; • be able to present an informatic topic; • be able to lead a scientific discussion.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar (Seminar)	
Examination: Seminartalk (approx. 45 Min.) with written report (max. 7 S.) **Examination prerequisites:** Active Participation **Examination requirements:** Independent preparation and presentation of research-related topics from the area of computational neuroscience / neuroinformatics as well as biophysics of neuronal systems.	4 C

Admission requirements: none	**Recommended previous knowledge:** B.Phy.5614
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1 - 3
Maximum number of students: 14	

Georg-August-Universität Göttingen **Module M.Phy.5604: Biomedicine imaging physics and medical physics**	6 C 4 WLH
Learning outcome, core skills: After taking this course, students will have quantitative insight into the physical, mathematical and algorithmic foundations of imaging techniques for biomedical applications, in particular CT, MRI, tomographic reconstruction, image processing, nuclear techniques, ultrasound and laser-tissue interaction up to emerging techniques such as phase contrast radiography. Further, the course leads a basic understanding of medical physics in a broader sense, including radiotherapy, radiobiology.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Vorlesung (Lecture)	
Examination: Written examination (120 Min.) or oral examination (approx. 30 Min.) or Presentation (approx. 30 Min., 2 weeks preparation time) **Examination requirements:** Knowledge of physical principles in medical diagnostics and therapy, in particular modern imaging techniques: Radiography (Absorptions- and Phase contrast), tomography, magnetic resonance imaging () positron-emissions-tomography, single photon emission tomography (SPECT), nuclear methods and probes, ultrasound imaging, optical microscopy. Along with the experimental principles, the algorithmic and mathematical concepts of image reconstruction and processing have to be mastered.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: German, English	**Person responsible for module:** Prof. Dr. Tim Salditt
Course frequency: every 4th semester; alle 2 jahre	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 2 - 4
Maximum number of students: 50	

Georg-August-Universität Göttingen **Module M.Phy.5608: Liquid State Physics**	4 C 2 WLH

Learning outcome, core skills: Lernziele/Kompetenzen: Students should learn the core concepts of the theories and experimental phenomenology of the liquid state, from simple to macromolecular/polymeric to granular liquids. Through readings of the important papers, both seminal or at the fore-front of research, they should learn how to understand the modern open questions regarding the liquid state. Students should also explore a specific topic that is currently subject of active research, and prepare an oral presentation and a written handout at the end of the semester.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Liquid State Physics *Contents*: This course will cover the foundations of the theoretical and experimental description of simple liquids, macromolecular/polymeric liquids and granular liquids and gases. We will learn about the statistico-mechanical approach to the liquid state, including distribution function theories, Boltzmann equation and Navier-Stokes equation. We will then move on to the dynamics of macromolecular liquids such as polymers. Based on concepts like viscosity and visco-elasticity, we will also explore thin film flows and non-Newtonian phenomena. The final part of the course will consider liquids composed of “macroscopic molecules” like sand grains. While their flow behavior is often reminiscent of molecular liquids, the dissipative nature of their interaction makes them an intrinsic out of equilibrium phenomenon.	

Examination: Presentation (ca. 40 min.) and handout on special topic of choice **Examination prerequisites:** Participation in course discussion and assignments **Examination requirements:** Students will perform an in-depth investigation on a particular course topic, and present this in a symposium at the end of the course.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** StudiendekanIn der Fakultät für Physik; Ansprechpartner Dr. Marco Mazza
Course frequency: unregelmäßig	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

3 times	Master: 1 - 4
Maximum number of students: 50	

Additional notes and regulations: SP: Biophysik/nichtlineare Dynamik; Festkörperphysik; Materialphysik; Astrophysik; Geophysik

Georg-August-Universität Göttingen **Module M.Phy.561: Advanced Topics in Biophysics/Physics of complex systems I**	6 C 6 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Biophysics and Physics of Complex Systems	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Course (6 C) in the field of Biophysics and Physics of Complex Systems	
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination prerequisites:** M.Phy.561.Mp **Examination requirements:** Advanced experimental techniques or theoretical models in Biophysics and Physics of Complex Systems.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.562: Advanced Topics in Biophysics/Physics of complex systems II**	6 C 4 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Biophysics and Physics of Complex Systems.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Course (3 C) in the Field of Biophysics/Physics of complex systems	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Biophysics and Physics of Complex Systems	3 C
Course: Course (3 C) in the Field of Biophysics/Physics of complex systems	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Biophysics and Physics of Complex Systems	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.566: Seminar Advanced Topics in Biophysics/Complex Systems**	4 C 2 WLH

Learning outcome, core skills: After successful completion of the modul students should be familiar with the presentation of complext problems, scientific discussion as well as evaluation of contents of the presentations.	**Workload:** Attendance time: 28 h Self-study time: 92 h

Course: Seminar Advanced Topics in Biophysics/Complex Systems	
Examination: Lecture, 4 weeks preparation time (approx. 60 minutes) **Examination prerequisites:** active Participation **Examination requirements:** Advanced experimental techniques or theoretical models in astro- or geophysics	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen Module M.Phy.5701: Advanced Solid State Theory	6 C 6 WLH
Learning outcome, core skills: After successful completion of the modul students should be able to perform calculations using many-body techniques, describe and model simple experimental observations, understand and use the language of modern solid-state theory.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Courses: **1. Lecture** **2. Exercises**	 4 WLH 2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Quantum-field theoretical description of solids, elements of ab initio methods, symmetries and binding, optical properties of solids, correlated electron systems, elements of transport theory. Formulation of theories based on experimental observation, description and interpretation of experiments in solids, knowledge of manybody techniques	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Solid State Physics Quantum mechanics I
Language: English	**Person responsible for module:** Dean of Studies, Faculty of Physics
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 2 - 3
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.5705: Materials Physics I: Microstructure-Property-Relations**	4 C 3 WLH
Learning outcome, core skills: After successful completion of this Module, the student will have obtained an overview about the realistic structure of materials (realistic = including defects and irregularities). In addition, a deepened understanding of the relation between micro-structure and fundamental material properties will have been gained via the discussion of theoretical models and experimental results.	**Workload:** Attendance time: 42 h Self-study time: 78 h
Course: Lecture and exercises *Contents*: Basic concepts of structure-property relations and defects, topology, thermodynamics and properties of defects, microstructure and mechanical properties.	
Examination: Presentation (approximately 30 minutes) or written examination (120 minutes) or oral examination (approximately 30 minutes) **Examination prerequisites:** Participation in exercise classes or completion of homework problem sheets or participation in discussions during lectures can be set at the start of the lectures as prerequisites for participation in the examination. **Examination requirements:** Global and local symmetries in materials, elastic continuum theory, structure of pointdefects, dislocations and grain boundaries, thermodynamics of defects, mechanical /chemical / electronic / transport properties of defects, as well as methods for the investigation of micro-structure and related properties.	4 C

Admission requirements: none	**Recommended previous knowledge:** Introductory courses in materials science and solid state physics.
Language: English	**Person responsible for module:** Prof.in Cynthia Volkert
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Phy.5706: Materials Physics II: Kinetics and Phase Transformations**	4 C 3 WLH
Learning outcome, core skills: After successful completion of this Module, the student will have obtained an overview of theoretical concepts and mechanisms of phase transformations in materials. In addition, a deeper understanding of the description of kinetic processes in the framework of irreversible thermodynamics will have been gained.	**Workload:** Attendance time: 42 h Self-study time: 78 h
Course: Vorlesung und Übung *Contents*: Fundamentals and specific examples of the behavior of condensed matter systems in non-equilibrium situations.	
Examination: Presentation (approximately 30 minutes) or written exam (120 minutes) or oral examination (approximately 30 minutes) **Examination prerequisites:** Participation in exercise classes or completion of homework problem sheets or participation in discussions during lectures can be set at the start of the lectures as prerequisites for participation in the examination. **Examination requirements:** Non-equilibrium thermodynamics, generalized driving forces, diffusion, nucleation, motion and instabilities of interfaces, solidification, precipitation, domain growth, spinodal decomposition, order-disorder phase transitions, kinetically controlled transformations.	4 C

Admission requirements: none	**Recommended previous knowledge:** Introductory courses in materials science and solid state physics, as well as the course Materials Physics I.
Language: English	**Person responsible for module:** Prof.in Cynthia Volkert
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 2 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.Phy.5707: Materials research with electrons	3 C 2 WLH
Learning outcome, core skills: Fundamentals of the application of electron microscopy to the characterization and analysis of materials, with emphasis on: * Interactions between electrons and solids * Preparation of samples, limits of electron microscopy * Fundamentals and advanced concepts of electron microscopy * Diffraction and imaging * Analytical applications (EDX, EELS, GPA, …) * Overview of current research topics After successful completion of this Module, the student will be able to understand further developments of electron microscopy and gain access to current research themes.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Materials research with electrons (Lecture)	
Examination: Oral examination, (approximately 30 minutes) **Examination requirements:** Understanding of fundamental concepts, facts, and methods. Basic understanding of diffraction, imaging, and analysis.	3 C

Admission requirements: none	**Recommended previous knowledge:** Introductory courses in materials science and solid state physics.
Language: English	**Person responsible for module:** apl. Prof. Dr. Michael Seibt
Course frequency: Every 2 years, summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Phy.571: Advanced Topics in Solid State/Materials Physics I**	6 C 6 WLH

Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Solid State/Materials Physics	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: A course (6 C) in the field of Solid State/Materials Physics	

Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Solid State/Materials Physics	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.572: Advanced Topics in Solid State/Materials Physics II**	6 C 4 WLH

Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Solid State/Materials Physics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Course (3 C) in the field of Solid State/Materials Physics	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Solid State/Materials Physics	3 C

Course: Course (3 C) in the field of Solid State/Materials Physics	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Solid State/Materials Physics	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.576: Seminar Advanced Topics in Solid State/Materials Physics**	4 C 2 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with the presentation of complext problems, scientific discussion as well as evaluation of contents of the presentations.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar Advanced Topics in Solid State/Materials Physics	
Examination: Lecture, 4 weeks preparation time (approx. 60 minutes) **Examination prerequisites:** active participation **Examination requirements:** Advanced experimental techniques or theoretical models in Solid State/Materials Physics	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.5801: Detectors for particle physics and imaging**	3 C 3 WLH

Learning outcome, core skills: After successful completion of this module, students should be familiar with modern methods and questions about detector physics in high energy physics, imaging and related fields.	**Workload:** Attendance time: 42 h Self-study time: 48 h

Course: Vorlesung mit Übung	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Based on the introductory lecture "interactions between radiation and matter" this lecture covers special topics of detector physics such as the layout of certain detector types (i.e. semiconductor detectors, ionisation detectors etc.), readout systems and noise contribution, radiation damage of detector material and readout as well as the application of such detectors.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: every 4th semester; irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 1 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.Phy.5804: Simulation methods for theoretical particle physics**	3 C 3 WLH

Learning outcome, core skills: **Learning Outcome:** The aim of the lecture is to convey the theoretical foundations of simulations of particle-physics scattering experiments. While the relevant theoretical concepts get introduced and discussed in the lectures, the tutorials provide hands-on experience with corresponding computer codes. **Competencies:** The successful participation in the module the students will have experience with the tools and methods used in high-energy particle physics research. They will be in a position to carry out corresponding calculations and understand contemporary research subjects	**Workload:** Attendance time: 42 h Self-study time: 48 h

Courses:	
1. Tutorial Simulation methods for theoretical particle physics	1 WLH
2. Lecture Simulation methods for theoretical particle physics (Lecture)	2 WLH

Examination: written (30 Min.) or oral exam (ca. 30 Min.) **Examination requirements:** Solid understanding of the foundations of the theoretical description of high-energy scattering experiments. Ability to carry out corresponding calculations and simulations.	3 C

Admission requirements: keine	**Recommended previous knowledge:** Quantum mechanics II, Quantum Field Theory
Language: English	**Person responsible for module:** Jun.-Prof. Dr. rer. nat. Steffen Schumann
Course frequency: every 4th semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Phy.5807: Particle Physics III - of and with leptons**	6 C 6 WLH

Learning outcome, core skills: After successful completion of this module, students should be familiar with the properties and interactions of leptons as well as with experimental methods and experiments which lead to their discovery and are used for precise studies.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: Lecture and exercises - Particle Physics III	

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Discovery of leptons, properties of leptons, weak interactions and V-A structure, neutral currents, standard model of particle physics, e+e- physics at LEP, fermion pair production at varying center of mass energy, lineshape of cross-section at Z-pole, number of light neutrino generations, forward-backward-asymmetry, tau-polarisation, e+e- physics at the LHC, (g-2)_myon, neutrinos and neutrino oscillations, solar neutrinos, atmospheric neutrinos, long-baseline experiments, neutrino factories, neutrino mass, neutrinoless double-beta decay	6 C

Admission requirements: none	**Recommended previous knowledge:** Introduction to Nuclear/Particle Physics
Language: German, English	**Person responsible for module:** Prof. Dr. Arnulf Quadt
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** Master: 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Phy.5809: Axiomatic Quantum Field Theory**	3 C 3 WLH
Learning outcome, core skills: **Acquisition of knowledge:** Axiomatic settings and general structure theorems of relativistic quantum field theory; Symmetries and representations; Exact models (two spacetime dimensions, especially with conformal symmetry). **Competences:** The students shall be familiar with the model-independent concepts and structures of relativistic Quantum Field Theory. They understand the transfer between complementary approaches.	**Workload:** Attendance time: 42 h Self-study time: 48 h
Courses:	
1. Axiomatic Quantum Field Theory (Lecture)	2 WLH
2. Axiomatic Quantum Field Theory (Exercise) *Contents*: in-class problems	1 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Mastery of the conceptual framework and elementary methods of proof. Application in concrete situations.	3 C

Admission requirements: none	**Recommended previous knowledge:** Classical Field Theory I, QM I, II
Language: English	**Person responsible for module:** apl. Prof. Dr. Karl-Henning Rehren
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Phy.581: Advanced Topics in Particle Physics I	6 C 6 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Particle Physics	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: A Course (6 C) in the field of Particle Physics	
Examination: Written examination (120 Min.) or oral examination approx. 30 Min.) or talk (approx. 30 Min.),2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Particle Physics	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.582: Advanced Topics in Particle Physics II**	6 C 4 WLH
Learning outcome, core skills: After successful completion of the modul students should be familiar with advanced concepts of Particle Physics	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: A Course (3 C) in the field of Particle Physics	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Particle Physics	3 C
Course: A Course (3 C) in the field of Particle Physics	2 WLH
Examination: Written exam (120 min) or oral exam (ca. 30 min) or talk (ca. 30 min), 2 weeks preparation time **Examination requirements:** Advanced experimental techniques or theoretical models in Particle Physics	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 2 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen Module M.Phy.586: Seminar Advanced Topics in Particle Physics	4 C 2 WLH
Learning outcome, core skills: After successful completion of this module, students should be able to reproduce and present complex chains of arguments, assess their own and other students' presentation critically.	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: Seminar Advanced Topics in Particle Physics	
Examination: Lecture, 4 weeks preparation time (approx. 60 minutes) **Examination prerequisites:** Active participation **Examination requirements:** Preparation of complex topics for presentation and scientific discussion.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.Phy.601: Development and Realization of Scientific Projects**	9 C
Learning outcome, core skills: After successful completion of the module, students should be able to carry out the planning and the "controlling" of scientific research projects independently. They should ... • tbe able o use Literature Databases systematically; • have a good command of modern word processors; • have skills in good scientific practice.	**Workload:** Attendance time: 0 h Self-study time: 270 h
Course: Development and Realization of Scientific Projects	
Examination: written report (max. 30 S.)	
Examination requirements: Use of Literature Databases, good command of modern word processors	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 3 - 4
Maximum number of students: 150	

Georg-August-Universität Göttingen **Module M.Phy.602: Networking**	3 C
Learning outcome, core skills: **Objectives:** Formulation of proposals, registration, funding and participation in congresses **Competences:** After successful completion of the module the student should have gained networking skills.	**Workload:** Attendance time: 0 h Self-study time: 90 h
Course: Networking	
Examination: written report (max. 10 S.), not graded	
Examination requirements: Networking and application in scientific and professional environment on student's own initiative.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Studiendekan/in der Fakultät für Physik
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 3 - 4
Maximum number of students: 150	

Georg-August-Universität Göttingen **Module M.Phy.603: Writing scientific articles**	6 C 2 WLH

Learning outcome, core skills: **Objective:** Basics of writing a scientific paper, form and and content of a Scientific paper, correspondence with scientific journals, understanding and imparting of content of current research, scientific discussion with co - authors **Competences:** After successfully completing the module students should know how to... • write a scientific article • submit a publication in the respective field • impart their independently developed effort	**Workload:** Attendance time: 28 h Self-study time: 152 h

Courses:	
1. Workshop	1 WLH
2. Accompanying Seminar	1 WLH

Examination: written report (max. 20 S.), not graded **Examination prerequisites:** active participation	6 C

Examination requirements: a) Writing scientific articles b) Submit sciientific publications	

Admission requirements: The Bachelor Thesis has to... • meet high academic standards • be a scientific progress in the science • be an independent performance The determination of the access authorization is performed by the module responsible. She/He may request the opinion of an authorized examinator in the related field.	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Dean of Studies of the Faculty of Physics
Course frequency: each semester; nach Bedarf	**Duration:** 2 semester[s]
Number of repeat examinations permitted: 3 times	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A01: Organic livestock farming under temperate and tropical conditions**	6 C 4 WLH

Learning outcome, core skills: Animal Welfare I: Students should acquire a basic understanding of animal welfare, familiarize with practical problems and scientific concepts including how to assess animal health and welfare at different process levels. Advances in animal nutrition and animal health: Students are introduced in scientific methods and approaches, appropriate to estimate and assess problems within organic livestock production in relation to imbalances in nutrient supply and production diseases. Sustainable forage production systems: Students are able to assess relationships between sward management and structural (yield, botanic) and functional (nutrient efficiency) sward characteristics. Organic livestock farming in the (sub)tropics: Students are able to discuss under which conditions organic livestock farming can be introduced in (sub)tropical countries or regions.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Courses:	
1. Animal Welfare I (Lecture) *Contents*: Principles of animal welfare in organic livestock farming; scientific methods to assess animal health and welfare.	1 WLH
2. Advances in animal nutrition and animal health (Lecture) *Contents*: Advances in animal nutrition and animal health; possibilities and limitations within organic livestock farming to ensure a high level of animal health; strategies within animal nutrition to increase the efficiency in the use of limited resources; system-oriented approach versus technical approaches.	1 WLH
3. Sustainable forage production systems (Lecture) *Contents*: Sustainable forage production systems; design and management of a sustainable forage production; management of forage quality and biodiversity on grassland; minimizing nutrient losses towards water and atmosphere.	1 WLH
4. Organic livestock farming in the (sub)tropics (Lecture) *Contents*: Characterization and evaluation of organic livestock farming systems in different locations of southern regions/countries; pros and cons of organic livestock farming under different bio-physical and socioeconomic conditions.	1 WLH

Publikationen zu Fallstudien werden über eine E-learning Plattform bereitgestellt	
Examination: Written examination (120 minutes) **Examination requirements:** Animal Welfare (Prof. Dr. Knierim) Basic knowledge in scientific concepts of animal health and welfare and in organic livestock farming; scientific methods to assess animal welfare. Animal nutrition and Animal health (Prof. Dr. Sundrum) Basic knowledge regarding organic cattle and pig production in Europe and possibilities and limitations within organic livestock farming to ensure a high level of animal health; strategies within animal nutrition to increase the efficiency in the use of limited resources in a system-oriented approach. Sustainable forage production (Prof. Dr. Wachendorf) Knowledge in the function of the sustainable development of forage crops, productivity and quality of grassland in relation to local conditions and management. Organic livestock farming in the (sub)tropics (Prof. Dr. Schlecht) Knowledge about the characterization and evaluation of organic livestock farming systems under (sub)tropical conditions; bio-physical and socioeconomic pros and cons of organic livestock farming in different regions.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Albert Sundrum
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 27	

Additional notes and regulations:

Literature:

Animal Welfare I:

Appleby, M.C., Hughes, B.O. (eds) 1997: Animal welfare. CAB International,

Wallingford; Vaarst, M. et al. (eds.) 2004: Animal health and welfare in organic agriculture. CAB International, Wallingford.

Advances in animal nutrition and animal health:

Sundrum, A. (2012): “Healthy food” from healthy cows. In: Konvalina, P. (ed.), Organic Farming and Food Production. InTech Book, p. 95-120.

Sundrum, A. (2012): Health and welfare of organic livestock and its challenges. In J. Ricke & O’Bryan (ed.), Organic meat production and processing. Wiley-Blackwell p. 89-112.

Sundrum, A. (2007): Quality production in organic, low-input and conventional pig production. In: Cooper, J., U. Niggli, C. Leifert (eds.). Handbook of Organic Food Safety and Quality. Woodhead Publishing, p. 144-177.

Sustainable forage production systems:

Hopkins, A. 2000: Grass, its production and utilization. Blackwell Science, Oxford, UK;

Cherney J.H. 1998: Grass for Dairy Cattle CABI Publishing, Exon, UK; Frame, J. 1992:

Improved Grassland Management. Farming Press Books, Ipswich, UK.

Organic livestock farming in the (sub)tropics:

Different publications of case studies are provided via an E-learning platform.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A02M: Epidemiology of international and tropical animal infectious diseases**	6 C 4 WLH
Learning outcome, core skills: Based on a scientific and practical up-to-date level, students know to evaluate and develop modern and effective livestock hygiene and husbandry concepts and to integrate them into complex quality management programs. Graduates are trained to be competent in implementing and communicating their knowledge in a multidisciplinary occupational setting that establishes epizootic control programs.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Epidemiology of international and tropical animal infectious diseases (Lecture, Exercise) *Contents*: Infectious diseases play an enormous role in international animal health control. National health and veterinary authorities, as well as international organizations (WHO, FAO) are very much involved in the surveillance of epidemics and establishment of health and hygiene monitoring programs. These efforts will increase in future, because of a further globalization of international markets, and will require well-educated experts collaborating worldwide in this multidisciplinary field. This module will give a generalized view of current epidemics together with a specialized understanding of infectious diseases and hygienic programs in subtropical and tropical countries. Characteristics of the biology of relevant infectious agents like parasites, fungi and bacteria together with their toxins, viruses, and prions will be presented in detail. Some of these germs included in this unit cause severe zoonotic diseases with a lethal danger for humans. Immunological host-defence mechanisms of wild and domestic farm animals against pathogens will be discussed together with modern strategies of active and passive immunizations. Diagnostic methods presently available and new biotechnological approaches in future assay and vaccine development will be demonstrated. The adaptation of practical health and standardized quality management processes to various animal production systems (ruminants, pigs, poultry) and the corresponding management measurements will be explained. The view will deeply focus on environmental impacts (water, soil, air hygiene), epizootiology and modern tools in epizootiological research. It will include biology and eradication of vectors (insects, ticks) transmitting pathogens of animal and zoonotic diseases, as well as biological and chemical methods for vector control. In the laboratory course, this module will also communicate well-established techniques of microbiological and parasitological diagnostics. Students will be practically trained in classical methods and in modern biochemical, immunological, biotechnological and molecular biological techniques for the detection of infectious agents, toxins and noxious substances. Tissue culture procedures for vaccine or antibody development are also used. Modification of livestock-environment interactions through human management are discussed.	4 WLH
Examination: Oral examination (approx. 90 minutes)	6 C

Examination requirements: Knowledge of current veterinary epidemic and infectious diseases inclusive emerging diseases. Background of hygiene and eradication programs. Profound knowledge in important infectious agents (parasites, fungi, bacteria, viruses) as well as toxins and prions. Skills in immunologic defense mechanisms of wildlife, zoo and domesticated animals in connection with modern active and passive vaccination strategies and biotechnological vaccine development. Knowledge in modern diagnostic tools as well as in biology and control of biological vectors (ticks, midges).	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Dr. Claus-Peter Czerny
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:

Literature:

Lecture based materials.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A03M: International and tropical food microbiology and hygiene**	6 C 4 WLH
Learning outcome, core skills: Based on a scientific and practical up-to-date level, students know to evaluate and develop modern and effective food hygiene concepts and to integrate them into complex quality management programs. Graduates are competent to implement and to communicate their knowledge in a multidisciplinary occupational area establishing epizootic control programs in food microbiology and hygiene. They are able to understand international experts of public health authorities and collaborate in international and multidisciplinary platforms including control, monitoring, and research.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: International and tropical food microbiology and hygiene (Lecture, Exercise) *Contents*: Infectious and toxic pathogens cause most of the food-borne impacts on human health all over the world. Global markets require an international surveillance system together with standardized food hygiene regulations. This module will give a generalized view of currently and internationally relevant food-borne zoonotic diseases, epidemics and food hygiene programs together with a specialized view on the conditions in subtropical and tropical countries. The biology of infectious agents (parasites, fungi, yeasts, bacteria, viruses, prions, together with their toxins) responsible for contaminations and intoxications of human food of animal origin will be discussed in detail. Some of these germs cause severe zoonotic diseases with a lethal potential for humans or certain age groups. Special characteristics of germ resistance in the food matrices meet, milk and eggs as well as in the corresponding products are elucidated along the complete manufacturing processes: from stable to table. Deterioration and spoilage of foodstuffs by microorganisms will be discussed as well. Diagnostic methods presently available for the detection of contaminated or spoiled nourishments and new biotechnological approaches in future assay designs will be analysed. The adaptation of practical hygiene and standardized quality management adjustment factors to various animal production systems (ruminants, pigs, poultry) as well as to the subsequent production processes will be explained together with the corresponding management measurements. This includes food conservation procedures, germ depletion and eradication techniques (cleaning, disinfection, autoclaving, sterilization). Beside negative microbial effects influencing food quality, positive effects especially of bacteria and fungi in food production will also be presented. Biotechnological aspects of genetic engineering of foodstuff supplements or directed genetic germ design will be discussed. In a laboratory course on food microbiology, this module will also communicate well-established techniques of microbiological and parasitological diagnostics in food matrices. Students will be practically trained in classical methods and in modern biochemical, immunological, biotechnological and molecular biological techniques for the detection of food-borne infectious agents, toxins and noxious substances.	4 WLH

Vorlesungsbegleitende Materialien	
Examination: Oral examination (approx. 90 minutes) **Examination requirements:** Knowledge in current food-borne zoonoses, programs in food hygiene and requirements for their implementation in tropical and subtropical countries. Background of the biology of infectious agents, tenacity of special microorganisms and microbial spoilage of foodstuffs, available diagnostic tools for detection of contaminated or spoiled foodstuffs and about new biotechnological diagnostic assays. Skills in practical hygiene norms, normative documents and standardized international quality management systems, foodstuff conservation, germ depletion and inactivation as well as in positive influences of bacteria and fungi on foodstuff production.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Dr. Claus-Peter Czerny
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations:
Literature:

Lecture based materials.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.A04: Livestock reproduction physiology	6 C 4 WLH
Learning outcome, core skills: Strong foundation in reproduction physiology as well as the development of creative potential and the fostering of independent thought are of focus; Other skills students develop include gathering and integrating information on how to solve problems; effective communication skills; self learners; as well as awareness of global issues driving changes in livestock sciences.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Livestock reproduction physiology (Lecture, Excursion, Exercise) *Contents*: Functional anatomy of reproduction; physiology of reproduction in livestock (hormones, growth factors, ovigenesis and fertilization, spermatogenesis, reproductive cycles, mating behaviour, fertilization, gestation, prenatal physiology, parturition, postpartum recovery, lactation); assisted reproductive technologies (artificial insemination, pregnancy diagnosis, preservation of embryos, embryo transfer, in vitro fertilization, sexing, cloning, transgenics); stem cells; ethics. Hafez B., Hafez, E.S.E. 2000: Reproduction in Farm Animals 7th ed. Lippincott Williams & Wilkins Publishing; Bearden, H.J., Fuquay, J.W., Willard, S.T. 2004: Applied Animal Reproduction, 6th ed. Pearson Prentice Hall Publishing; Squires, E.J. 2003: Applied Animal Endocrinology 1st ed. CABI Publishing; Pineda, M.H., Dooley, M.P. 2003: Mc Donald's Veterinary Endocrinology and Reproduction 5th ed. Blackwell Publishing. Senger P.L. (2003): Pathways to pregnancy and parturition (2nd edition). Current conceptions, Inc.	4 WLH
Examination: Oral examination (approx. 30 minutes, 70%) and written report (max. 10 pages, 30%) **Examination requirements:** The examinee should show her/his potential to understand the principles of reproductive physiology and to illustrate profound differences among various livestock species. Special focus will also be laid on the species-specific application of advanced assisted reproductive technologies.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal sciences
Language: English	**Person responsible for module:** Prof. Dr. sc. agr. Christoph Knorr
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 10	

Additional notes and regulations:
After successful conclusion of M.Agr.0069, M.Agr.0070 and B.Agr.0331 students can not complete M.SIA.A04

Literature:

Hafez B., Hafez, E.S.E. 2000: Reproduction in Farm Animals 7th ed. Lippincott Williams & Wilkins Publishing; Bearden, H.J., Fuquay, J.W., Willard, S.T. 2004: Applied Animal Reproduction, 6th ed. Pearson Prentice Hall Publishing; Squires, E.J. 2003: Applied Animal Endocrinology 1st ed. CABI Publishing; Pineda, M.H., Dooley, M.P. 2003: Mc Donald's Veterinary Endocrinology and Reproduction 5th ed. Blackwell Publishing. Senger P.L. (2003): Pathways to pregnancy and parturition (2nd edition). Current conceptions, Inc.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.A05: Aquaculture in the tropics and subtropics	6 C 4 WLH
Learning outcome, core skills: Students get to know basic principles of aquaculture and the ecological and socio- economic aspects of this resource utilization. They see the functions of aquaculture¿in system relationships and know the distinct utilisation variants. They are capable of analysing the advantages and disadvantages of the different aquaculture systems and are able to evaluate the possibilities of a sustainable intensification of such systems in a multidisciplinary approach.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Aquaculture in the tropics and subtropics (Lecture, Excursion, Exercise) *Contents*: This module provides an introduction to aquaculture in the tropics and subtropics with a focus on fresh-water fish farming. This resource can be managed independently or integrated with other ecological and socioeconomic aspects. The module covers: • biological and ecological principles; • aquaculture and aqua-agriculture systems; • tropical fish candidates and their performance in relation to production systems; specific breeding and raising methods; • functions and products of aquaculture. Vorlesungsbegleitende Materialien	4 WLH
Examination: Oral examination (approx. 20 minutes) **Examination requirements:** Knowledge of the biological and ecological aquaculture in the tropics, the various aquaculture systems, as well as integrated agri-aquaculture systems. Knowledge about tropical fish species and their production efficiency in relation to production systems, as well as knowledge of specific breeding and husbandry practices and socio-economic functions and products of aquaculture.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Gabriele Hörstgen-Schwark
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:

Literature:

Lecture based notes.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A06: Global aquaculture production, markets and challenges**	6 C 4 WLH
Learning outcome, core skills: Students get to know the most important aquaculture organisms worldwide as well as their prevalent production systems. They learn which national and international regulatory mechanisms influence trade of aquatic products. Through the work on case studies and their presentations, students obtain the capability to evaluate problems, chances and socioeconomic impacts of a globalized and sustainable aquaculture; they are enabled to independently get acquainted with scientific subjects and to apply the acquired knowledge for the consideration of complex conflicts of interest.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Global aquaculture production, markets and challenges (Lecture, Seminar) *Contents*: The production of the world wide most important aquaculture species and ornamentals (i.e. kelp, water hyacinths, water salad, oysters, clams, carp, tilapia, salmon, trout, Litopenaeus vannamei, Penaeus monodon), their distribution channels; national and international markets and trade with aquatic products; international trading agreements, law and their compliance; national and international legislation for the protection of the aquatic environment; aquatic animal health, trade and transboundary issues. Through case studies: Trends and developments of sector management (influence of national authorities, NGOs, societies, communities); socioeconomic impact of aquaculture; contribution to national food self-sufficiency; energy and resource efficiency in aquaculture; environmental management of aquaculture. *Literature:* Lecture based notes. *Course frequency:* jedes Wintersemester	4 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Project presentation (ca. 20 minutes) **Examination requirements:** Knowledge of the most important aquaculture organisms, their distribution structures, and the national and international markets and trade of aquatic products. Knowledge of the laws, national and international rules to protect the aquatic environment and the standards of hygiene and fish health in cross-border trade.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal sciences and agricultural markets
Language:	**Person responsible for module:**

English	Prof. Dr. Gabriele Hörstgen-Schwark
Course frequency: every 4th semester; Start WS 15/16; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A09: Sustainability in organic livestock production under temperate conditions**	6 C 4 WLH

Learning outcome, core skills: System approach in livestock production Reflection on differences in approaches within livestock production from a scientific and practice-oriented perspective following the aim to establish a farm as a sustainable agro-ecosystem. Animal welfare II Students have an advanced understanding of the ethical and biological basis of animal welfare and of scientific animal welfare concepts and methods, in particular in relation to organic husbandry principles.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Courses:	
1. System approach in livestock production (Seminar) *Contents*: Basics of system theory; how to assess the performances and emergent properties of farm systems; differences between technical and systematic approaches in livestock production with respect to different production goals; possibilities and limitations of a systematic approach to improve animal health and efficiency in the use of limited resources. Appleby, M.C., Hughes, B.O. (eds) 1997: Animal welfare. CAB International, Wallingford; Vaarst, M. et al. (eds.) 2004: Animal health and welfare in organic Agriculture. CAB International, Wallingford UK	2 WLH
2. Animal Welfare II (Seminar) *Contents*: Ethics, scientific concepts in animal welfare research, reflection on the different dimensions of welfare on the basis of current scientific papers and taking into account organic principles Appleby, M.C., Hughes, B.O. (eds) 1997: Animal welfare. CAB International, Wallingford; Vaarst, M. et al. (eds.) 2004: Animal health and welfare in organic Agriculture. CAB International, Wallingford UK.	2 WLH
Examination: Homework (max. 30 pages) or presentation (ca. 20 minutes) (50%) and oral exam (ca. 15 minutes, 50%) **Examination requirements:** Knowledge about the potentials and strategies to improve nutrient efficiency when making use of home-grown and bought-in nutrients and to improve animal health status on the farm level in a systemic approach. Advanced knowledge of the ethical, biological and methodological basis of animal welfare research and of animal welfare in organic husbandry.	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowledge (B.Sc. level) of animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Ute Knierim
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:
Literature:

System approach in livestock production

Sundrum, A. (2007): Achievements of research in the field of livestock systems. In: Rosati, A., A. Tewolde, C. Mosconi (eds.). Animal Production and animal science worldwide. WAAP book of the year 2006. Wageningen Academic Publishers, p. 95-106. (available in moodle)

Animal welfare II

Appleby, M.C. et al. (Eds.) (2011): Animal welfare. 2nd ed., CABI, Wallingford; Vaarst, M. et al. (eds.) 2004: Animal health and welfare in organic
Agriculture. CAB International, Wallingford UK.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A10: Livestock nutrition and breeding under (sub)tropical conditions**	6 C 4 WLH

Learning outcome, core skills: Students are able: • to describe the effects of abiotic and biotic environmental influences on behaviour and physiology of different livestock species and to discuss respective adaptation strategies of animals; • to analyse the opportunities and limitations of feeding, management and breeding strategies for an optimization of livestock production under specific agro-ecological settings; • to individually explain and discuss such topics for a selected livestock species or breed in an oral seminar presentation or written essay.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Livestock nutrition and breeding under (sub)tropical conditions (Lecture, Seminar) *Contents*: This module analyses the physiological basis of livestock husbandry in the Tropics and Subtropics. The adaptation of the most widely used livestock species (cattle, small ruminants, camelids, buffalo, poultry, pigs) to the climatic conditions and to qualitatively and quantitatively variable fodder supply is studied. Possibilities to reduce the negative impact of environmental factors on animal production through adapted management strategies are analyzed. Opportunities and limitations of breeding strategies for the improvement of animal production under the given ecological and economic conditions are discussed and evaluated. Allocation of lecturing time: 50% animal nutrition, 50% animal breeding Payne; W.J.A., Wilson, R.T. 1999: An Introduction to Animal Husbandry in the Tropics. Blackwell Science Ltd., Oxford, UK; Van Soest, P.J. 1994: Nutritional Ecology of the Ruminant. Cornell University Press, Ithaca, US; Wiener, G. 1994: Animal Breeding (Tropical Agriculturist). Macmillan Education, Edinburgh, UK [ISBN-13: 978-0333572986].	4 WLH
Examination: Oral exam (ca. 20 minutes, 75%) and homework (max. 5 pages, 25%) **Examination requirements:** Nutrition part (10 minutes, 50% weight): basics of animal nutrition in (sub-)tropical environments; macro- and micro-nutrients, digestive physiology, feed conversion; interdependency between animal nutrition and health, concept of nutritional wisdom. Breeding part (10 minutes, 50% weight): basics of animal breeding in (sub-)tropical environments; production traits, secondary traits, lifetime productivity, heritability, breeding value, methods to determine breeding value; breeding strategies for the most important livestock species in (sub-)tropical counties.	6 C

Admission requirements: none	**Recommended previous knowledge:**

	Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:

Payne; W.J.A., Wilson, R.T. 1999: An Introduction to Animal Husbandry in the Tropics. Blackwell Science Ltd., Oxford, UK;   Van Soest, P.J. 1994: Nutritional Ecology of the Ruminant. Cornell University Press, Ithaca, US;   Wiener, G. 1994: Animal Breeding (Tropical Agriculturist). Macmillan Education, Edinburgh, UK [ISBN-13: 978-0333572986].

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A11: Tropical animal husbandry systems**	6 C 4 WLH

Learning outcome, core skills: Students are able to: understand the impact of the natural and economic environment on the evolution of different types of husbandry systems as well as on their orientation and intensity of production; gain understanding for parameters that have to be considered when aiming at the improvement of livestock husbandry systems within a given framework; individually analyse and present a specific tropical livestock production system.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Tropical animal husbandry systems (Lecture, Seminar) *Contents*: This module provides an extensive overview on the different forms of animal husbandry systems in developing and transformation countries of Africa, Asia and Latin America, ranging from camel nomadism in deserts to beef ranching and intensive dairying in tropical highlands. The system-specific strategies of livestock management are analysed in view of their ecological and economic sustainability. The (potential) interactions of livestock with other components of the farming system are explored, thereby differentiating between market and subsistence oriented systems. The role of additional factors influencing livestock production systems such as cultural, social, economical and political frame conditions are discussed. Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C. 1999: Livestock to 2020. The next food revolution. FAO Discussion Paper 28, FAO Rome, Italy; Devendra, C., Thomas, D., Jabbar, M.A. and Zerbini, E., 2000: Improvement of Livestock Production in Crop-Animal Systems in Agro-ecological Zones of South Asia. ILRI, Nairobi, Kenya; Falvey, L., Chantalakhana, C. (eds) 1999: Smallholder Dairying in the Tropics. ILRI, Nairobi, Kenya	4 WLH
Examination: Written exam (90 minutes, 75%) and oral seminar presentation (ca. 15 minutes, 25%) **Examination requirements:** abiotic and biotic conditions of animal husbandry in the (sub-)Tropics; characteristics, opportunities/constraints of pastoral, agro-pastoral, silvo-pastoral, aquatic, industrial and urban systems; species-specific management and production (cattle, sheep, goat, camel, yak, pig, poultry).	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of plant and animal sciences or agricultural economics
Language:	**Person responsible for module:**

English	Prof. Dr. Eva Schlecht
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C. 1999: Livestock to 2020. The next food revolution. FAO Discussion Paper 28, FAO Rome, Italy; Devendra, C., Thomas, D., Jabbar, M.A. and Zerbini, E., 2000: Improvement of Livestock Production in Crop-Animal Systems in Agro-ecological Zones of South Asia. ILRI, Nairobi, Kenya; Falvey, L., Chantalakhana, C. (eds) 1999: Smallholder Dairying in the Tropics. ILRI, Nairobi, Kenya

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.A13M: Livestock-based sustainable land use	6 C 4 WLH
Learning outcome, core skills: To understand the interactions of livestock with the natural resource base and their site- and management specific positive or negative environmental impacts; To get acquainted with and test methodological approaches used in field research on livestock-environment interactions; To learn about simple modelling approaches and the significance of their results.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Livestock-based sustainable land use (Lecture, Exercise) *Contents*: This module highlights the general positive and negative impacts of livestock and livestock management on the natural resources (air, water, soil vegetation), specifically under (sub)tropical conditions, at the plot to the watershed scale. It discusses options for sustainable livestock-based land use, thereby building upon the beneficial impacts of animals on soils and plants. Management options for reducing negative environmental effects of livestock (gaseous emissions, nutrient excretion) are highlighted, and possibilities for consolidating the interests of livestock keepers with international conventions are discussed. The students are introduced, in lectures, own reading and practical field tests to up-to-date quantitative and qualitative methods that are used in studies on animal-environment interactions. Simple modelling approaches that depict animal-environment interactions at the plot level up to the watershed scale are presented and tested by the participants. Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., de Haan, C. 2006: Livestock's long shadow. Fao, Rome, Italy; Specific scientific articles, distributed in the course.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Influences of animal husbandry / the individual animal on its environment: soil fertility and soil erosion, pasture vegetation, nutrient transfers, greenhouse gas emissions; livestock keeping versus nature conservation; methods for assessing quality and quantity of pasture vegetation; methods to determine the animal's behavior at pasture and its feed intake.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., de Haan, C. 2006: Livestock's long shadow. Fao, Rome, Italy; Specific scientific articles, distributed in the course.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E02: Agricultural price theory**	6 C 4 WLH
Learning outcome, core skills: Significance of prices from individual and societal viewpoint, agricultural price structure, role of technical change, vertical and spatial price formation, price formation in quota markets, futures and forward contracts.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Agricultural price theory (Lecture) *Contents*: This module is designed to provide students with an introduction to the theory and measurement of price formation on agricultural markets. Students will learn about price formation and price linkages over space and time, and how prices on markets in different locations and/or for products of different levels of processing are linked with one another. They will also learn about special examples of price determination that are unique (land markets) or especially common (markets influenced by quota schemes) in agriculture. A final focus will be placed on future markets and their possible use as a risk management tool in agriculture and agribusiness. Vorlesungsbegleitende Materialien	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of impact of prices from an individual and macroeconomic point of view, of agricultural price structure as well as the importance of the technical progress, vertical and spatial price formation, price formation in the farm land market and the quoted market, as well as of commodities future markets	6 C

Admission requirements: none	**Recommended previous knowledge:** Background in agricultural markets and policy recommended
Language: English	**Person responsible for module:** Prof. Dr. Bernhard Brümmer
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 60	

Additional notes and regulations:
Literature:

A script and a variety of supplemental reading will be provided.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E05M: Marketing research	6 C 4 WLH
Learning outcome, core skills: Students (i) are able to outline the steps in a marketing research process; (ii) are able to develop a marketing research design; (iii) know all relevant methods for data collection, analysis and prognosis with their specific advantages and problems; (iv) elaborate written and oral presentations in teamwork.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Marketing researches (Lecture, Seminar) *Contents*: Tasks and management of marketing research; methods of data collection; methods of data analysis, methods of prognoses. - Aaker, D.A., Kumar, V., Day, G.S. (2011): Marketing research. 10thed., Hoboken, NJ: Wiley. - Bryman, A. (2008): Social Research Methods. 3rded., Oxford: Oxford University Press. - Burns, A.C., Bush, R.F. (2006): Marketing Research. 5thed., Upper Saddle River, NJ, et al.: Prentice Hall. - Denzin, N.K., Lincoln, Y.S. (2008): Strategies of qualitative inquiry. 3rded., Los Angeles, CA, et al.: Sage Publications. - Churchill, G.A., Brown, T.J. (2007): Basic marketing research. 6thed., Mason, OH: Thomson South Western. - Dillman, D.A., Smyth, J.D., Christian, L.M. (2009): Internet, mail, and mixed-mode surveys. 3rded., Hoboken, NJ: Wiley. - Greenbaum, T.L. (2000): Moderating focus groups. A practical guide for group facilitation. Thousand Oaks, CA, et al.: Sage Publications. - Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. (2009): Multivariate data analysis, 7thed., Upper Saddle River, NJ, et al.: Prentice Hall. - Malhotra, N.K., Birks, D.F., Wills, P. (2012): Marketing research, 4thed., Harlow, Pearson. - McQuarrie, F. (1996): The marketresearchtoolbox:aconciseguideforbeginners. Thousand Oaks, CA, et al.: Sage Publications. - Ritchie, J., Lewis, J. (2006): Qualitative research practice: A guide for social science students and researchers. London et al.: Sage Publications. - Shao, A.T., Zhou, K.Z. (2007): Marketing research. 3rded., London et al.: Thomson Learning. - Webb, J.R. (2005): Understanding and designing marketing research. 2nded., London: Thomson Learning. - Wooldridge, J.M. (2006): Introductory econometrics – a modern approach. 3rded., Mason, OH, et al.: Thomson South Western.	4 WLH

Examination: Presentation (ca. 20 minutes) with written outline (max. 5 pages) (50%) and oral exam (ca. 30 minutes) (50%) **Examination requirements:** Knowledge of tasks and management of marketing research; methods of data collection; methods of data analysis, methods of prognoses.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on marketing
Language: English	**Person responsible for module:** Prof. Dr. Ulrich Hamm
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations:

Literature: Aaker, D.A., Kumar, V., Day, G.S. (2013): Marketing research. 11th ed., Hoboken, NJ: Wiley. - Bryman, A. (2008): Social Research Methods. 3rd ed., Oxford: Oxford University Press. - Burns, A.C., Bush, R.F. (2010): Marketing Research. 6th ed., Upper Saddle River, NJ, et al.: Prentice Hall. - Denzin, N.K., Lincoln, Y.S. (2008): Strategies of qualitative inquiry. 3rded., Los Angeles, CA, et al.: Sage Publications. - Churchill, G.A., Brown, T.J. (2007): Basic marketing research. 6thed., Mason, OH: Thomson South Western. - Dillman, D.A., Smyth, J.D., Christian, L.M. (2009): Internet, mail, and mixed-mode surveys. 3rd ed., Hoboken, NJ: Wiley. - Greenbaum, T.L. (2000): Moderating focus groups. A practical guide for group facilitation. Thousand Oaks, CA, et al.: Sage Publications. - Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. (2009): Multivariate data analysis, 7th ed., Upper Saddle River, NJ, et al.: Prentice Hall. - Malhotra, N.K., Birks, D.F., Wills, P. (2012): Marketing research, 4th ed., Harlow, Pearson. - McQuarrie, F. (1996): The market research toolbox: a concise guide for beginners. Thousand Oaks, CA, et al.: Sage Publications. - Ritchie, J., Lewis, J. (2006): Qualitative research practice: A guide for social science students and researchers. London et al.: Sage Publications. - Shao, A.T., Zhou, K.Z. (2007): Marketing research. 3rd ed., London et al.: Thomson Learning. - Webb, J.R. (2005): Understanding and designing marketing research. 2nd ed., London: Thomson Learning. - Wooldridge, J.M. (2006): Introductory econometrics – a modern approach. 3rd ed., Mason, OH, et al.: Thomson South Western.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E06: International markets and marketing for organic Products**	6 C 4 WLH
Learning outcome, core skills: (i) Analysis of international markets for organic products; International trade (ii) Import regulations for organic products in different countries; (iii) Import regulations for agricultural products in the EU; (iv) Export market research and analysis from the viewpoint of developing countries; (v) Marketing strategies for the export of organic products; (vi) Marketing measures for the export of organic products; (vii) Case study for export of organic products from a developing country to the EU.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: International markets and marketing for organic products (Lecture, Seminar) *Contents*: (i) Analysis of international markets for organic products; International trade (ii) Import regulations for organic products in different countries; (iii) Import regulations for agricultural products in the EU; (iv) Export market research and analysis from the viewpoint of developing countries; (v) Marketing strategies for the export of organic products; (vi) Marketing measures for the export of organic products; (vii) Case study for export of organic products from a developing country to the EU Jain, S.C. 2001: International marketing, 6th ed., South Western Thomson Learning, Cincinatti; Kotler, P., Keller, K.L. 2006: Marketing management, 12th ed., Pearson Prentice Hall, Upper Saddle River; Schmid, O., Hamm, U., Richter, T., Dahlke, A. 2004: A guide to successful organic marketing initiatives. Research Institute of Organic Agriculture, Frick/Switzerland; Wilson, R.M.S., Gilligan, C. 2003: Strategic marketing management, 2nd ed., Elsevier Amsterdam.	4 WLH
Examination: Presentation (ca. 20 minutes) with written outline (max. 5 pages) (50%) and oral exam (approx. 30 minutes) (50%) **Examination requirements:** Knowledge of tasks and approaches in market research as well as knowledge of data survey methods, prognosis methods and analysis methods.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on marketing
Language: English	**Person responsible for module:** Prof. Dr. Ulrich Hamm
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:
Literature:

Literature: Development of organic agriculture world wide - Lockeretz, W. (ed.) (2007): Organic farming: An international history. CABI, Wallingford/UK. - Willer, H. and Kilcher, L. (eds.) (2012): The world of organic agriculture. Frick/Switzerland. - http://www.soel.de - http://www.ifoam.org - http://www.fao.org - http://www.orgprints.org General political framework for imports of organic products in the EU - http://eur-lex.europa.eu/en/legis/20110301/chap03.htm Marketing concepts - Armstrong, G., Kotler, P., Harker, M. and Brennan, R. (2009): Marketing. An Introduction. 9th ed., Pearson Education, Harlow/England (European version) - Doyle, P. and Stern, P. (2006): Marketing management and strategy. 4th ed., FT Prentice Hall, Hemel Hempstead/UK - Jain, S. C. (2001): International marketing management. 6th ed., South Western, Cincinnati, Ohio/USA - Kotler, P. and Keller, K. L. (2006): Marketing management. 12th ed., Prentice-Hall Pearson, Upper Saddle River, New Jersey/USA - Schmid, O., Hamm, U., Richter, T. and Dahlke, A. (2004): A guide to successful organic marketing initiatives. Organic marketing initiatives and rural development vol. 6, Research Institute of Organic Agriculture, Frick/Switzerland - Wilson, R. M. S. and Gilligan, C. (2005): Strategic marketing management. 3rd ed., Butterworth-Heinemann, Oxford/UK - Zander, K., Hamm, U., Freyer, B., Gössinger, K., Hametter, M., Naspetti, S., Padel, S., Stolz, H., Stolze, M. and Zanoli, R. (2010): Farmer Consumer Partnerships – How to successfully communicate the values of organic food consumers. University of Kassel.http://orgprints.org/17852/1/CORE_FCP_Handbook_en_2010.pdf

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E11: Socioeconomics of rural development and food security**	6 C 4 WLH
Learning outcome, core skills: Students learn concepts of development and problem-oriented thinking in a development policy context. The identification of interdisciplinary linkages is trained. Building on case-study analyses, course participants can pinpoint appropriate economic and social policies and assess their impacts. These qualifications can also be transferred to unfamiliar situations.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Socioeconomics of rural development and food security (Lecture) *Contents*: This module provides students with an overview of socioeconomic aspects of hunger and poverty in developing countries. Apart from more conceptual issues and development theories, policy strategies for rural development and poverty alleviation are discussed and analyzed. Special emphasis is put on problems in the small farm sector. Numerous empirical examples are used to illustrate the main topics.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Concepts and measurement of hunger and poverty; development theory; classification and evaluation of rural development policies	6 C

Admission requirements: none	**Recommended previous knowledge:** Prior knowledge of microeconomics at the BSc level is useful
Language: English	**Person responsible for module:** Prof. Dr. Matin Qaim
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 120	

Additional notes and regulations:
Literature:

Text books, research articles and lecture notes.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E12M: Quantitative research methods in rural development economics**	6 C 4 WLH

Learning outcome, core skills: Students are familiar with empirical, quantitative methods in rural development economics. Thus, they are able to develop and implement their own research projects.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Quantitative research methods in rural development economics (Lecture) *Contents*: This module teaches and trains methodological skills for the analysis of micro data in rural development economics. In particular, farm and household level data are used. Apart from statistical and econometric techniques, approaches of primary data collection are covered (questionnaire development, survey sampling design). These methods are used for concrete examples in the computer lab.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Use and interpretation of descriptive statistics and standard econometric methods; hypothesis testing; data management; sampling design.	6 C

Admission requirements: Familiarity with the contents of the module "Socioeconomics of Rural Development and Food Security" is assumed.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Matin Qaim
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations: **Literature:** Text books, research articles and lecture notes.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E13M: Microeconomic theory and quantitative methods of agricultural production**	6 C 4 WLH

Learning outcome, core skills: Microeconomic Theory of Agricultural Production Students are familiar with microeconomic approaches and can apply them to analyze issues related to agriculture and rural development. Quantitative Methods in Agricultural Business Economics Students are familiar with quantitative methods used for the analysis and planning of farms and enterprises in the agricultural sector.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Microeconomic theory of agricultural production (Lecture) *Contents*: Consumer theory, producer theory, markets, monopoly situations, risk and uncertainty, economics of technical change, farm household models, sharecropping contracts.	2 WLH
2. Quantitative methods in agricultural business economics (Lecture) *Contents*: Budgeting, accounting, annual balance sheets, linear programming, finance, investment analysis	2 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Consumer theory; producer theory; risk; technological progress; farm household models; budgeting and accounting; linear programming; finance; investment analysis	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Matin Qaim
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations:

Literature:

Text books, research articles and lecture notes.

After successful conclusion of M.Agr.0060 students can not complete M.SIA.E13M

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E14: Evaluation of rural development projects and policies**	6 C 4 WLH
Learning outcome, core skills: Students know the major methods for the evaluation of rural development projects and policies. They apply these methods for concrete project examples and thus are able to design and carry out evaluations independently.	**Workload:** Attendance time: 40 h Self-study time: 140 h
Course: Evaluation of rural development projects and policies (Lecture) *Contents*: This module teaches and trains the standard methods for the evaluation of rural development projects and policies. In particular, this includes impact assessment as well as cost-benefit analysis. These methods are used for concrete project and policy examples.	4 WLH
Examination: Written exam (90 minutes, 50%) and presentation (ca. 25 minutes, 50%) **Examination requirements:** Cost-benefit analysis; development project evaluation; impact assessment; targeting of projects and interventions	6 C

Admission requirements: none	**Recommended previous knowledge:** Knowledge of the content of the module "Socioeconomics of Rural Development and Food Security" is required.
Language: English	**Person responsible for module:** Prof. Dr. Matin Qaim
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 65	

Additional notes and regulations:

Literature:

Text books, research articles and lecture notes.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E17M: Management and management accounting	6 C 4 WLH
Learning outcome, core skills: The main aim of the module is to acquaint students with the theory and practice of management and management accounting/control, and the role of environmental, social and governance issues therein. More specifically, the aims of the module are: • To provide students with insights into different theoretical perspectives; an understanding of the implicit assumptions held by each perspective as well as the implications of these perspectives for management practice and research; • To provide students with the conceptual and practical skills necessary to effectively understand and critically analyse management/corporate practice; • To provide students with practical experience in and knowledge about “managing and accounting for sustainability”; • To enable students to understand why traditional accounting and accountability do not serve managers and other corporate stakeholders well in the light of increasing demands for social accountability, transparency and social responsibility	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Management and management accounting (Lecture, Seminar) *Contents*: • The fundamentals of management practice, the roles and functions undertaken by managers; • The development and evolution of management theory; • A critical reflection on the wider responsibilities of management (incl. moral decision-making, managing for sustainability); • An introduction to the traditional accounting and accountability theory and practice; key management accounting and control systems and concepts; performance measurement and management; • The developments in new accounting and accountability tools and their role (and limitations) in supporting managerial decision making and increasing transparency on environmental, social and sustainability performance. Lussier, R.N. 2006: Management fundamentals – Concepts, Applications, Skill Development, Thomson, London, UK; Robbins, S.P., Coulter, M. 2007: Management, 9th edition, Pearson, Upper Saddle River; Drury, C. 2005: Management Accounting for Business, Thomson, London, UK; Atkinson, A.A., Kaplan, R.S., Young, S.M. 2004: Management Accounting, 4th Edition, Upper Saddle River.	4 WLH
Examination: Presentation (ca. 15 minutes, 50%) and written examination (90 minutes, 50%) **Examination requirements:** Students should demonstrate a sound understanding of the management / management accounting concepts and frameworks (written exam). Students are also expected to apply the knowledge acquired in class to a case study company and to present and discuss their findings with others (workshops incl. role play and group work).	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Herzig, Chrstian, Prof. Dr.
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 35	

Additional notes and regulations:

Literature:

Lectures and short lectures combined with facilitated group discussion; seminars include case study-based group work and exercises

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E18: Organization of food supply chains	6 C 4 WLH
Learning outcome, core skills: Students are introduced into various issues of the organizational design of food supply chains and agribusiness firms. Students learn to write a seminar paper and they are also able to independently acquire additional knowledge by advanced literature search. The preparation and presentation of selected topics as well as the contribution to oral discussions during seminar sessions will be examined. The comprehensive overview of various organizational theories enables the students to identify and classify complex organizational problems in food supply chains and develop solutions.	**Workload:** Attendance time: 68 h Self-study time: 112 h
Course: Organization of food supply chains (Seminar) *Contents*: The module introduces into basic concepts of organizational design in food supply chains and the agribusiness sector. The students write a paper based on the combination of a selected organizational theory and a practical example. The students present their papers and discuss the various organizational issues with high importance for the food and agribusiness sector. Key aspects of the lecture are: - Stakeholder management for farms and agribusiness firms - Efficient organizational design of food supply chains: Contracts, open markets, vertical integration - Competitive strategy and the organizational design of food supply chains - Certification schemes from an organizational perspective - Cooperatives and the organization of food supply chains - Transparency of food supply chains The seminar makes use of various organizational theories and provides students with insights into the practical implications of these theories. Vorlesungsbegleitende Materialien	4 WLH
Examination: Homework (max. 15 pages, 65%) and 2 presentations (about 45 min, 20% and about 15 min, 15%), not graded **Examination requirements:** Ability to write a paper based on the combination of a selected organizational theory and a practical example, to present the paper, serve as a discussant of the paper of another group and discuss the various organizational issues with high importance for the food and agribusiness sector. 1. Presentation: ca. 45 minutes presenting the contents of the own homework; 2. Presentation: ca. 15 minutes discussing the homework of another group of participants.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge food supply chains and agribusiness management
Language: English	**Person responsible for module:** Verena Otter

Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 21	

Additional notes and regulations: Students are not allowed to take the module M.Agr.0053 if they have passed M.SIA.E18.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E19: Market integration and price transmission I**	6 C 4 WLH

Learning outcome, core skills: Students gain insight into the functioning of the price mechanisms on agricultural markets and into the determinants of market integration. They learn to apply econometric analysis methods to the study of horizontal and vertical price transmission processes (time series methods, cointegration, including non-linear cointegration and non-linear error correction models).	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Market integration and price transmission I (Lecture) *Contents*: Theory and empirical analysis of agricultural market integration	4 WLH
Examination: Written examination (60 minutes) **Examination requirements:** Students are able to explain the economic theory of price transmission and market integration (e.g. how can we explain the prevalence of asymmetric price transmission on agricultural markets), and are able to apply the most important methods of empirical price transmission analysis (in particular the econometric estimation of error correction models).	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of econometrics
Language: English	**Person responsible for module:** Prof. Dr. Stephan von Cramon-Taubadel
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations: **Literature:** A list of seminar papers (Garnder, Ravallion, Goodwin, Fackler, Barrett) will be circulated to students, together with a list of recent applications.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E21: Rural sociology**	6 C 4 WLH

Learning outcome, core skills: One of the primary objectives of this course is to introduce students to the principles of sociology in general and key concepts of environmental and rural sociology in particular. In addition, we want to provide the analytical tools for understanding the processes inherent to these concepts. Beyond that, the course aims at enhancing students' ability to identify different research perspectives and to critically discuss and analyze research strategies and methods.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Rural Sociology (Lecture, Seminar) *Contents*: As an introduction to environmental and rural sociology, this course is designed to give an overview of the sociological concepts on “nature-society relations”, “social structural developments and social problems in rural areas”, “social networks and social capital in communities”, “social dilemmas and sustainability”, “social movements and the environment”, and “environmental justice”. Lectures outline each of these issues and position them within the context of sociology. We will use seminars to debate key questions raised during lectures and to discuss selected issues based on academic publications. Geeignete Quellen werden in der Vorlesung vorgestellt; Lehrbuchkapitel liefern Grundlagenmaterial und werden durch Artikel aus wissenschaftlichen Fachzeitschriften ergänzt.	4 WLH
Examination: Term Paper (max. 20 pages) **Examination requirements:** Darstellung von und kritische Auseinandersetzung mit Theorien, Konzepten und Methoden im Bereich der Umweltsoziologie sowie Land- und Agrarsoziologie.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:**
Course frequency: each summer semester; not 2014 Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:
Literature:

Adequate literature is presented in the lecture; text book chapters supply basic knowledge and are complemented by scientific publications.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E23: Global agricultural value chains and developing countries**	6 C 4 WLH

Learning outcome, core skills: The students will become familiar with the application of these models through empirical examples and the discussion of journal articles.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Global Agricultural Value Chains and Developing Countries (Lecture) *Contents*: This lecture deals with the impacts of restructured and globalized agricultural markets on small-scale farmers and traders in developing countries. Current developments and changes on agricultural markets are analyzed and the implications for developing countries discussed. Approaches of the value chain analysis and the promotion of pro-poor value chains are explained. Emphasis will be laid on the roles of institutions for the performance of markets in developing countries, especially against the background of recent developments. Models of contract theory, institutional and transaction costs economics are conveyed and used to analyze the situation in developing countries.	4 WLH
Examination: Presentation (ca. 30 minutes, 50%) and written exam (45 minutes, 50%) **Examination requirements:** Specific knowledge of contract theory, economics of transaction costs and institutions as well as the application of the concepts to current aspects with the context of developing countries. Understanding of the role of institutions regarding the mechanism of agricultural markets.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations: **Literature:** Selected articles from academic journals and book chapters

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E24: Topics in rural development economics I	6 C 4 WLH
Learning outcome, core skills: The objective of this course is to acquaint Master students with the reading and understanding of scientific journal articles on relevant topics of rural development economics. Student should learn how to develop a scientific research question, choose appropriate research methods and strucutre a scientific article.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Topics in Rural Development Economics I (Lecture) *Contents*: This course will provide Master Students with an overview of relevant topics in rural development economics, which will also enable them to develop own research questions and study approaches in this field. The module is structured as a reading course, building on selected articles from relevant international journals. Students are required to read announced articles before the classroom sessions, in order to enable a critical debate in class. The articles selected for the course are clustered around key topics relevant to rural development economics, such as listed below. Tentative Topics 1. The food system transformation and smallholder farmers 2. Rural livelihood strategies and income diversification 3. Adoption and impact of modern agricultural technology 4. Economics of nutrition and health 5. Gender and intra-household resource allocation Master students will have to write a summary of a selected journal article. Furthermore, the course should enable them to develop own research questions and study approaches in the field of rural development economics.	4 WLH
Examination: Presentation (ca. 45 minutes, 40%) and homework (max. 8 pages, 60%) **Examination requirements:** Constructive participation in the discussion during the lectures, which requires the reading of the articles indicated. In both the written and the oral assignments, students are supposed to demonstrate that they are able to identify the most relevant aspects of the articles and to critically evaluate the research questions, the methods and the results of the studies .	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency:	**Duration:**

each summer semester; Göttingen	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Selected articles from academic journals and book chapters

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E28: Regional modelling	6 C 4 WLH

Learning outcome, core skills: This module will teach the students the basic and advance knowledge of secondary data bases. Students will gain knowledge and experience in static as well as in system dynamic regional modelling	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Regional Modelling (Lecture, Exercise) *Contents*: This lecture will teach basic and advanced knowledge on how to analyse regional effects of development instruments and investments. In the exercises accompanying the lectures, students will practice the basics of modelling with a number of examples. Bryden, J.M. et al., 2010. Towards Sustainable Rural Regions in Europe Exploring Inter-relationships between Rural Policies, Farming, Environment, Demographics, Regional Economies and Quality of Life using System Dynamics, London: Routledge	4 WLH
Examination: Presentation (ca. 20 minutes, 50%) with written outline (max. 20 pages, 50%) **Examination requirements:** Grund- und fortgeschrittene Kenntnisse der Analyse von Regionalen Effekten von Investitionen und der Entwicklung von Regionen.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of regional economics and regional statistical data bases
Language: German, English	**Person responsible for module:** Dr. sc. agr. Holger Bergmann
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations:

Literature:

Bryden, J.M. et al., 2010. Towards Sustainable Rural Regions in Europe Exploring Interrelationships between Rural Policies, Farming, Environment, Demographics, Regional
Economies and Quality of Life using System Dynamics, London: Routledge

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E30M: Social research methods	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
• are able to independently plan and design their research. • are able to independently design questionnaires for qualitative and quantitative research. • know the principles of transcribing and coding qualitative data and the principles of data preparation of quantitative data • know the principles of data collection and interviewer and interviewee relationship • know the relevant qualitative and quantitative social research methods • are aware of the differences of qualitative and quantitative research methods • are able to implement qualitative and quantitative methods in a mixed methods research design • know fundamentals of qualitative and quantitative data analyses • acquire skills to independently conduct qualitative and quantitative social research methods	Attendance time: 60 h Self-study time: 120 h

Course: Social Research Methods (Lecture, Seminar) *Contents*: This course is designed to lay the foundations of good empirical research in the social sciences. The seminar will first focus on the fundamentals of social research, including: the logic of scientific inquiry, developing qualitative and quantitative questionnaires, sampling, and measurement. This seminar will expose you to the diverse methods available to social scientists, including survey, qualitative interviews, qualitative comparative analysis, and discuss their strengths and weaknesses. Students become acquainted with a variety of approaches to research design, and are helped to develop their own research projects and to evaluate the products of qualitative and quantitative research.	
Examination: Written examination (90 minutes, 60%) and presentation (30 minutes, 40%) **Examination requirements:** Knowledge of current qualitative and quantitative methods. Background of current forms of data analysis. Profound knowledge of the relevant terms of qualitative and quantitative research. Skills in the application of methods and knowledge of the interpretation of data. Students should be able to understand and explain qualitative and quantitative research processes and read and explain tables and figures.	6 C

Admission requirements:	**Recommended previous knowledge:**
none	none
Language: English	**Person responsible for module:** Dr. Thomas Krikser
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E31: Strategic management**	6 C 4 WLH
Learning outcome, core skills: The aims of the module are: • To deepen the students' understanding of the unique aspects of food and agricultural production, processing, distribution, wholesaling and markets and their relationship with strategy; • To familiarise students with the development of strategies within a changing environment, to meet stakeholders' interests; • To provide students with the knowledge and confidence to make strategic business decisions; • To raise critical awareness of strategic decision-making in agrifood organisations.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Strategic management (Lecture, Seminar) *Contents*: • Concepts and frameworks used in strategic management; • The importance of values and purpose in defining an organisation's strategic goals; • The analysis of the complex environment of agrifood organisations and how it shapes the strategic behaviour of members of the value chain and an organisation's competitive environment; • A critical review of strategic frameworks (e.g. Porter's five forces, life cycle analysis); • The analysis of the internal environment (value creating activities, capabilities and resources); • An introduction to organisational and business strategies; • The management of stakeholder relations; • The relationship between organisation and strategy; • The management of strategic change and the role of strategic leadership.	
Examination: Presentation (ca. 15-20 minutes) with hand-out (max. 2 pages) (30%) and written report (max. 30 pages, 70%) **Examination requirements:** Students should demonstrate a sound understanding of the strategic management concepts and frameworks. Further requirements include: development of a research design to contribute to the development of a scenario analysis; collection and analysis of data in groups.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Herzig, Christian, Prof. Dr.
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Lectures and short lectures combined with facilitated group discussion; seminars include research based learning elements such as case studies and research activities involving students (e.g. scenario analysis).

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E33: Responsible and sustainable food business in global contexts**	6 C 4 WLH
Learning outcome, core skills: The aims of the module are: • To deepen the students' understanding of the role of food business in society and the social responsibility and accountability issues that arise in a global business setting; • To familiarise students with the concepts and frameworks used in responsible and sustainable food business, the development of business principles for responsible food businesses, to meet stakeholders' interests; To provide students with the knowledge and confidence to critically reflect corporate practice; • To raise awareness for different perspectives which provide contrasting and competing ways of making sense of responsible food business practices.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Responsible and sustainable food business in global contexts (Lecture, Seminar) *Contents*: This module explores issues related to responsible and sustainable food business in global contexts. Individual themes include: • The process of globalisation and its impact on the agrifood sector; • Corporate social responsibility, governance and accountability; • The role of transparency of products and markets in the context of an increasingly globalised world; • The scope, nature and types of international operations (and their managerial implications); • The management of global supply chains in the agrifood sector; • The management and reporting of environmental and social information in complex organisational settings (such as multinational food businesses); • The contrasting perspectives in social responsibility and accountability of business across borders.	4 WLH
Examination: Written report (in the form of a learning journal; 60%) and oral presentation (40%)	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christian Herzig
Course frequency: each winter semester; Witzenhausen/Kassel	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 35	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E34: Economic valuation of ecosystem services in developing countries**	6 C 4 WLH
Learning outcome, core skills: Students get introduced to the essential concepts and methods of interdisciplinary Ecosystem Services (ES) research. Special emphasis will be put on the integrated and systematic assessment of ES, including their dependencies of and impacts on biodiversity, climate change and development. Students will familiarize themselves with common methods of economic valuation of ES and learn about different examples of practical implementation in developing countries. Within the scope of a presentation and a term paper, students will review and evaluate selected scientific literature, process the findings in an environmental-economic analysis and compile results and derived policy recommendations for better maintenance, sustainable use and integration of ES into development planning.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Economic Valuation of Ecosystem Services in Developing Countries (Lecture, Seminar) *Contents*: • Integrated and interdisciplinary analysis of ES • Dynamic linkages between ES, biodiversity, climate change and development • Methods and applications of economic valuation of ES • Implementation examples from developing countries • Integration of ES in development planning (entry points to the policy cycle) • Practical application in a case study (literature work, monetary quantification)	4 WLH
Examination: Homework (max. 20 pages, 70%) and oral presentation (approx. 30 minutes, 30%) **Examination requirements:** For a given case study students will develop appropriate analytical strategies and implement them with the help of identified scientific literature. Methodological knowledge provided during the lectures will be essential for the case work. Most relevant results will be summarized in a presentation. The compilation of the term paper requires basic techniques of scientific literature research.	6 C

Admission requirements: none	**Recommended previous knowledge:** M.Agr.0079 Environmental Economics and Policy or similar skills
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 30	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E35: Institutional ecological economics**	6 C 4 WLH

Learning outcome, core skills: • Will become familiar with the basic understandings of ecological economics and their relation to the role of institutions and governance • Will become familiar with mainstream and critical approaches related to understandings of collective action and co-production involving higher levels of state authority in relation to regulating social ecological systems • Will be aware of prominent research designs and methods for analyzing the role of institutions in social-ecological systems (SES) • Will be able to illustrate their capacities in the context of discussing and developing research on the role of institutions and governance in empirical settings	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Institutional Ecological Economics (Lecture, Excursion, Seminar) *Contents*: The regulation of stocks and flows is core in Ecological Economics in order to maintain economies sustainable. This module engages specifically with regulations containing institutions and governance that shape collective action and co-production in relation to complex adaptive Social-ecological Systems. The module starts out with introducing the ecological economic model of the economy. In a detailed fashion it introduces the perspective of the Bloomington School of Political Economy for the analysis of institutions and governance of social-ecological systems. Core aspects here are the determinants of success and failure in collective action and co-production and related perspectives of co-management, collaborative management, polycentricity, adaptive governance, resilience, etc.. Subsequently, it treats some of the main criticisms of these kinds of approaches before it introduces the principal research designs and methods for analysing the role of institutions and governance in complex-adaptive social-ecological systems. Finally, knowledge is brought together in the context of developing research proposals addressing concrete empirical issues that are introduced by students or the excursion.	4 WLH
Examination: Term Paper (max. 12 pages) and presentation (about 10 minutes) (40%) and Term Paper (max. 17 pages) (60%) **Examination requirements:** • Basic understandings of ecological economics and their relation to the role of institutions and governance • Understanding and reflection of mainstream and critical approaches related to understandings of collective action and co-production involving higher levels of state authority in relation to regulating social ecological systems • Knowledge of prominent research designs and methods for analyzing the role of institutions in social-ecological systems (SES)	6 C

Admission requirements: none	**Recommended previous knowledge:**

	Background in agricultural and environmental policy and economics
Language: English	**Person responsible for module:** Prof.Dr. Andreas Thiel
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Further examination prerequisites:

Participation in the excursion and its preparation and evaluation

Literature:

Ostrom, E., 2005. Understanding institutional diversity. Princeton Univ. Press, Princeton, NJ.; further seminar papers will be circulated to students

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E36: Institutions and the food system**	6 C 4 WLH

Learning outcome, core skills: • Will become familiar with the role of institutions and governance in the food system • Will be familiar with public choice and political science approaches to the analysis of constitutions and policies and their change • Will be familiar with theories of decentral and central institutional change in the traditions of economics, political science and sociology • Will apply this conceptual knowledge concerning the role, performance and change of institutions and governance of a variety of aspects of food systems in different countries in and outside Europe • Will review global drivers of change of food and agricultural production systems	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Institutions and the food system (Lecture, Excursion, Seminar) *Contents*: Institutions are core elements structuring economic exchange in the food system. The course starts out with a discussion of what institutions are and what roles a stratified, multi-disciplinary concept of institutions has in food and agricultural systems and their change. Approaches will cover the study of institutions in classical and new institutional economics, in evolutionary economics, in economic sociology and in political sciences. Subsequently, discussions will be organized along public choice and constructivist approaches to understanding centrally driven institutional change on the one hand and economic and constructivist approaches to understanding decentral institutional change on the other. Discussions of the role of institutions for performance of the food and agricultural sectors and their change will be illustrated through ample recourse to examples drawn from studies of the food and agricultural production systems in and outside of Europe. That way, principal drivers of the change of food systems will be reviewed. In this regard, as far as possible examples will be drawn from one particular cultural, national or regional context. Ending the module, potentials and limits of researching the role of institutions in the food and agricultural sectors will be evaluated and corresponding research designs will discussed.	4 WLH
Examination: Oral exam (about 25 min., 60%) and term paper (max. 15 pages, 40%) **Examination requirements:** • Understanding of the role of institutions and governance in the food system • Knowledge of public choice and political science approaches to the analysis of constitutions and policies and their change • Knowledge of theories of decentral and central institutional change in the traditions of economics, political science and sociology • Application of conceptual knowledge concerning the role, performance and change of institutions and governance to a variety of aspects of food systems in different countries in and outside Europe • Knowledge of global drivers of change of food and agricultural production systems	6 C

Admission requirements: none	**Recommended previous knowledge:** Background in agricultural and environmental policy and economics
Language: English	**Person responsible for module:** Prof. Dr. Andreas Thiel
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Further examination prerequisites:

Participation in the excursion/ thematic day and its preparation/ evaluation

Literature:

Literature and seminar papers will be circulated to students at the beginning of term

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E37: Agricultural policy analysis**	6 C 4 WLH
Learning outcome, core skills: • Students get an overview on EU institutions and the history of the EU's common agricultural policy (CAP) • Students learn different theories and methods for the analysis of agricultural policies • Students learn how to analyse different policy measures and instruments and evaluate them	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Agricultural policy analysis (Lecture) *Contents*: **1. Introduction into Economic Policy and Economic Theory** Definition of agricultural policy, Analytical framework of economic analysis, Objectives, measures, institutions, The coordination process, a model for the economic process **2. Market Failure** Public Goods & externalities, Market power & monopolistic behavior, State intervention due to Instability of markets, State intervention & government failure, principal-agent theory **3. The European Union – A short introduction** History of the EU, the importance of the agricultural sector in the EU, institutions and political structure of the EU, decision-process in the EU, **4. The EU's common agricultural policy: Description and Analysis** The history and analysis of the Common Agricultural Policy (CAP) of the EU **5. Introduction into Environmental policy** Objectives, measures and analysis and interaction with agricultural policy **Literatur**: B. Hill (2013): Understanding the Common Agricultural Policy, Earthscan A. Cunha & A. Swinbank (2011): An Inside View of the CAP Reform Process, Oxford University Press A. Oskam, G. Meester & H. Silvis (2011): EU policy for agriculture, food and rural areas, Wageningen, University Press Swinnen, Johan F.M. (2008): The Perfect Storm – the political Economy oft he Fischler Reforms oft he Common Agricultural Policy, Centre for European Policy Studies, Brussels Krugman, P.R., M. Obstfeld & M.J. Melitz (2011), International Economics (9.Ed.), Pearson	
Examination: Written examination (90 minutes)	6 C

Examination requirements: • Fundamental knowledge of EU institutions and the EU's common agricultural Policy (CAP) • Knowledge of different theories and methods to analyze agricultural policies • Analysis of different measures and instruments of the EU's common agricultural policy (CAP)	

Admission requirements: none	**Recommended previous knowledge:** Microeconomics
Language: English	**Person responsible for module:** Dr. Sebastian Lakner
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I02: Management of (sub-)tropical landuse systems	6 C
Learning outcome, core skills: Enable students to understand the functioning and bio-physical limitations of (subtropical agro-pastoral land use systems, to argue for the need of interdisciplinary approaches to overcome these and to apply current research methods in land use systems analysis.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Management of (sub-)tropical landuse systems (Block course, Lecture) *Contents*: Witzenhausen: Plant-animal interactions, diet selection and nutritional wisdom, impact of grazing on pastures; statistical approaches to measure and cope with short-distance variability in crop growth; measurement techniques for nutrient fluxes in different agro-ecosystems. Prague: Land-use management: farm and family income in different farming systems, soil conservation technologies for smallholder farming systems, conservation tillage systems, potential use of waste-stream products to enhance soil productivity in tropical peri-urban and rural areas, crop diversity in tropical agricultural systems. Altieri, M. 1995: Agroecology, Westview Press, USA; Martius, C. 2002: Managing Organic Matter in Tropical Soils: Scope and Limitations. Kluwer Academic Publishers; Van Soest, P. 1994: Nutritional ecology of the ruminant. Cornell University Press, London, UK; Provenza, F.D. 1995: Post-ingestive feedback as an elementary determinant of food preference and intake in ruminants. Journal of Range Management, 48: 2-17.	
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge about: the ability of animals to select feed; animal-plant interactions; effects of grazing on grasslands and pastures; statistical methods and measurements material flows in various agroecosystems; landuse management; incomes in different operating systems; soil conservation measures for smallholders and soil conservation systems; potential use of waste products to increase productivity and the significance of agrobiodiversity.	6 C

Admission requirements: none	**Recommended previous knowledge:** Knowledge in plant, soil and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Andreas Bürkert
Course frequency: WiSe 13/14, einmal in 2 jahren, alternierend mit Modul I07; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 25	

Additional notes and regulations:

Literature:

Altieri, M. 1995: Agroecology, Westview Press, USA; Martius, C. 2002: Managing Organic Matter in Tropical Soils: Scope and Limitations. Kluwer Academic Publishers; Van Soest, P. 1994: Nutritional ecology of the ruminant. Cornell University Press, London, UK; Provenza, F.D. 1995: Post-ingestive feedback as an elementary determinant of food preference and intake in ruminants. Journal of Range Management, 48: 2-17.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.I03: Food quality and organic food processing**	6 C 4 WLH

Learning outcome, core skills: Students will be able to define food quality and quality systems in agriculture and food industry discuss principles of organic food production (agriculture, processing) according to EEC 2092/91) discuss and evaluate food processing techniques and quality assessment methods	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Food quality and organic food processing (Lecture) *Contents*: European and international legislation for organically produced agricultural commodities (focussing : Annex II, Annex VI EEC 2092/91; contracting, quality standards, product handling) Quality standard setting and the Organic Guarantee System Certification systems for organic and conventional products (overview, principles, concept, certification) Accreditation and accreditation agencies Process and product orientated food quality concepts and assessments; “holistic” quality definitions Processing techniques for organic food processing (different product groups) Quality assessment methods for small and medium-size enterprises Florkowski et al. 2000: Integrated View of Fruit and Vegetable Quality, Technomic; Welti-Chanes et al. 2001: International Congress on Engineering and Food, Volume I and II, Technomic; Luning et al. 2002: Food quality management, Wageningen Pers; Lawless et al. 1999: Sensory evaluation of Food, Kluwer; Kent et al.1994: Technology of cereals, Pergamon; Bidlack et al. 2000: Phytochemicals as bioactive agents, Technomic; Linden et al. 1994: New ingredients in food processing, CRC; Souci et al. 2000: Nutrition Tables, Medpharm	4 WLH
Examination: Presentation (ca. 20 minutes, 50%) and project work (max. 20 pages, 50%) **Examination requirements:** Knowledge about the quality of food in terms of concepts and criteria with focus on organic production. Insides in processing and management of organic food according the guidelines, standards and practices. Basic knowledge in the concepts of HACCP and QACCP.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowlegde in chemistry

Language: English	**Person responsible for module:** Dr. Nicolaas Busscher
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations:

Literature:

Florkowski et al. 2000: Integrated View of Fruit and Vegetable Quality, Technomic; Welti-Chanes et al. 2001: International Congress on Engineering and Food, Volume I and II, Technomic; Luning et al. 2002: Food quality management, Wageningen Pers; Lawless et al. 1999: Sensory evaluation of Food, Kluwer; Kent et al.1994: Technology of cereals, Pergamon; Bidlack et al. 2000: Phytochemicals as bioactive agents, Technomic; Linden et al. 1994: New ingredients in food processing, CRC; Souci et al. 2000: Nutrition Tables, Medpharm

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I06M: Exercise on the quality of tropical and subtropical products	6 C 4 WLH
Learning outcome, core skills: Students are able (i) to analyze and discuss experimental data considering economics and consumer expectations, (ii) to work with scientific primary literature, (iii) to elaborate written presentations in teamwork, (iv) to exchange their opinions about sensorial evaluation.	**Workload:** Attendance time: 40 h Self-study time: 140 h
Course: Exercise on the quality of tropical and subtropical products (Exercise) *Contents*: Exercises on quality properties of wheat, rice, potatoes, fruits and vegetables: Starch and protein quality of baking wheat; dough and baking properties of wheat, sensors of baking goods, rheological properties of rice flour and other starch containing products, cooking and frying properties of potatoes; consumer acceptance of potatoes; Marketing properties of fruits and vegetables; texture, ripeness, inner quality properties of fruit and vegetable (e.g. sugar/acid ratio, nitrate in leaf vegetable), sensors of fruit and vegetable juices. Belitz, Grosch, Schieberle 2004: Food Chemistry, 3rd rev. ed., Springer Berlin.	4 WLH
Examination: Project work (max. 40 pages) **Examination prerequisites:** Participation in all introductory meetings and at all experimental laboratory work **Examination requirements:** Knowledge about quality parameter of wheat, rice and starch containing products, potatoes, fruits and vegetables. Knowledge about starch and protein quality of baking wheat, sensoric properties of bread and bakery products, rheological properties of rice flour and other starch containing products, consumer acceptance of potatoes, marketing of fruits and vegetables, texture analysis, intrinsic quality parameter of fruits and vegetables and sensoric proerties of fruits and vegetables.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on agriculture production and chemistry
Language: English	**Person responsible for module:** Dr. Inga Smit
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 24	

Additional notes and regulations:

Literature:

Belitz, Grosch, Schieberle 2004: Food Chemistry, 3rd rev. ed., Springer Berlin.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I07: International land use systems research - an interdisciplinary study tour	6 C 8,5 WLH
Learning outcome, core skills: To gain multi- and interdisciplinary insights into (international) approaches towards opportunities and challenges of agro-silvo-pastoral production systems, sustainable resource use and agricultural development interventions. To familiarize participants with theoretical and practical questions of field research in an international contexts	**Workload:** Attendance time: 119 h Self-study time: 61 h
Course: International land use systems research - an interdisciplinary study tour (Lecture, Excursion, Seminar) *Contents*: Through the combination of one semester of preparatory impulse lectures and student seminars and the 12-14 day excursion to a (sub)tropical country, this module provides participants with interdisciplinary insights into the bio-physical and socio-economic components of agro-silvo-pastoral systems in the global context. The small- to large-size farm enterprises, processing plants and marketing organisations to be visited during the excursion exemplify the opportunities and challenges of agricultural activities in their specific context, whereby particular attention is paid to aspects of sustainability and environmental safety. The excursion targets regions where the two universities conduct research programmes, and also includes visits to partner universities and (inter)national research institutions. This will allow the MSc students to gain a first impression on how field research is organized and carried out in (sub)tropical countries. Up-to-date research approaches are presented to the participants, and questions targeting the sustainable use of natural resources as well as questions of development cooperation are discussed in an international and interdisciplinary context.	8,5 WLH
Examination: Oral exam (ca. 20 minutes, 50%) and oral seminar presentation (ca. 20 minutes) with written outline (max. 4 pages) (50%) **Examination prerequisites:** Day protocol of the excursion (max 2 pages) **Examination requirements:** The module and excursion contents are reviewed in an oral exam whereby two examiners are putting forward questions to the below topics (10 minutes each): A) Aspects of soil, plant, crop and forestry sciences pertaining to the regions and enterprises/farms visited during the excursion. B) Aspects of animal husbandry and socio-economic issues pertaining to the regions and enterprises/farms visited during the excursion.	6 C

Admission requirements:	**Recommended previous knowledge:**
none	Study focus on international agriculture and development policy

Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: Winter semester, every second year, alternating with Module I02; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:

Literature:

Specific general and scientific articles dealing with the excursion country, distributed in the course.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.I09: Sustainable nutrition**	6 C 6 WLH
Learning outcome, core skills: Students are able to describe the role of nutrition in human health use databases for RDA describe the influence of nutrition (from farm to fork) on environmental parameters (soil, water, atmosphere, biodiversity) understand tools to measure “sustainability” in nutrition systems.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Sustainabe nutrition (Lecture, Excursion) *Contents*: • Culture and cultural patterns of nutrition • Interactions of food quality and lifestyle on human health • Recommended Dietary Allowances (RDA), tools to evaluate nutritional and health status • Product flow in the food supply chain (world wide and from farm to fork) • Databases and tools to describe nutrition systems (e.g. Life cycle assessment) • Greenwashing or real green? Logos, guidelines, legal aspects	6 WLH
Examination: Presentation (ca. 15 minutes, 50%) with written outline (max. 15 pages, 50%) **Examination requirements:** Kenntnis von Ernährungsstilen und Lebensmittelqualität (in ausgewählten Ländern) Kenntnis von Methoden zur Erfassung von umweltrelevanten Parametern entlang der Lebensmittelkette (von der Landwirtschaft bis zum Verbraucher) Kenntnis rechtlicher Vorgaben zur Kennzeichnung von Lebensmitteln sowie Vorgaben zur Verarbeitung von nachhaltig produzierten Lebensmitteln und Marketing	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on biochemistry, statistics and environmental issues
Language: English	**Person responsible for module:** Prof. Dr. agr. Angelika Ploeger
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations:
Literature:

Will be provides via the system2teach platform.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I10M: Applied statistical modelling	6 C 4 WLH
Learning outcome, core skills: The aim of the course is to make students familiar with the basic concepts of 'linear models', the 'Generalized linear models' and 'non-parametric estimation procedures', which now belong to the standard methods in applied statistics. Furthermore, the practical application of the methods are taught using the statistical software package R.	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Applied statistical modelling (Lecture, Exercise) *Contents*: Statistical analysis in the agricultural sciences are based primarily on the use of linear models rer. They cover a wide range of applications concerning the distribution of the data and model assumptions, and ultimately allow the simultaneous estimation of fixed and random effects in mixed-th models. The understanding and application of mixed linear model implies detailed knowledge of matrix algebra, which will begin the course. The students are at the beginning of the course put in a position to formulate statistical models. Furthermore, the who-teaches the basics of programming in R, which is used for homework exercises used. Different types of linear models are built up gradually and learn how regression models, classification models, and finally mixed models with fixed and random effects. Other questions focus on multicollinearity, model selection criteria and the same model experiments, the corrected estimate mean values and the testing of hypotheses. Linear models are developed for generalized linear mixed models with link function for categorical distributed data or data that follow a Poisson distribution (count variable). Similarly, knowledge about non-parametric test procedures are taught. A variety of examples and exercises to deepen the theory learned permanently. Students are motivated on the basis of sample data sets to work on problems independently. This module generates a substantial understanding and basic knowledge about statistical Datenanalyse, which can be used for future scientific work in the context of master's or doctoral theses.	4 WLH
Examination: Written exam (90 minutes, 50%) and home work (max. 5 pages, 50%) **Examination requirements:** Knowledge in linear and generalized linear modeling as well as in non-paremetric estimation procedures. Ability for applying theoretical methods and modeling to real data by using the software package R.	6 C

Admission requirements: none	**Recommended previous knowledge:** Mathematics (linear algebra), Statistics
Language: English	**Person responsible for module:** Prof. Dr. Sven König
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:

Literature:

Lecture notes

Searle S. R. (1982) Matrix Algebra Useful for Statistics, Wiley Series in Probability and Statistics.

Mrode R. A. (2005) Linear Models for the Prediction of Animal Breeding Values, CABI Publishing.

Dobson A. & Barnett A. (2008) An Introduction to Generalized Linear Models, Chapman & Hall.

Wood S. (2006) http://www.amazon.co.uk/Generalized-Additive-Models-Introduction-R/dp/1584884746/ref=sr_1_6?ie=UTF8&s=books&qid=1228725710&sr=1-6Generalized Additive Models: An Introduction with R , Chapman & Hall..

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I11M: Free Project	6 C
Learning outcome, core skills: Students are able to plan and carry out a scientific project. This includes critical evaluation of publications and the ability to apply acquired knowledge to problems in the field or in economic or social sciences. Students are also able to present results and discuss them on the basis of their knowledge.	**Workload:** Attendance time: 0 h Self-study time: 180 h
Course: Free project *Contents*: A topic for a project is chosen in agreement with the instructor. The aim of the project is to gain profound scientific knowledge on the chosen topic. This can include experimental work. The result of the project can be a written thesis, an oral presentation and/ or an electronically stored result.	
Examination: Project work (roughly 15 pages or 4000 words) **Examination requirements:** In agreement with the instructor. Generally project work (roughly 15 pages or 4000 words).	6 C

Admission requirements: Written agreement with instructor on topic, form and time frame for the project.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stephan von Cramon-Taubadel
Course frequency: each semester; Göttingen oder Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:

Scientific publications on the topic agreed upon with the instructor.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.I12: Sustainable international agriculture: basic principles and approaches**	6 C 4 WLH
Learning outcome, core skills: Students • are able to describe the main bio-physical and socio-economic drivers shaping agricultural production systems and land and resource use strategies; • have knowledge of relevant ecological, economic and social indicators • can describe and apply integrated approaches of indicator use for the evaluation of a system's sustainability	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Sustainable International Agriculture: basic principles and approaches (Lecture) *Contents*: In view of global change spanning from population growth, migration, and urbanization to climate change, land degradation and water scarcity, the sustainable use of human and natural resources for the continued provision of quantitatively and qualitatively adequate food poses a major challenge to all stakeholders involved in agricultural production worldwide. This module therefore addresses the basic concepts and principles of sustainability and sustainable agriculture, in its ecological, economic and social dimensions. Approaches to determine the bio-physical and socio-economic sustainability of a land use systems and of agricultural value chains are evaluated, and possibilities to implement sustainable management strategies along the continuum of water, soils, plants, animals, producers and consumers are discussed, thereby also accounting for relevant temporal and spatial scales.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** **Barkmann (Soc-Econ):** general definitions and indicators for sustainable development; strong and weak sustainability; the substitution-paradigm and its limits; carrying capacity and critical natural capital; economic growth models; economic approaches for the quantification of sustainable development; SNA / green accounting; cost-benefit analysis. **Bürkert (Nat Sci):** concepts of sustainability; agroforestry systems; shifting cultivation; effects on soil fertility and sustainability. **NN (Soc-Econ):** dimensions of social sustainability; utilization of communal resources; McDonaldisation of agriculture; agriculture and social justice. **Ludwig (Nat Sci):** soils: textures; minerals; types; organic matter; functions and forms; N-dynamics. Water erosion; wind erosion: processes and rates; counteracting measures. Emissions of greenhouse gases (GHG) and ammonia: sources and processes; options of minimizing emissions. **Möller (Soc-Econ):** multi-functionality and farm-management; realization of sustainability concepts in the farm enterprise; agro-ecological systems and sustainable	6 C

farm management; indicators for enterprise sustainability; controlling of sustainability; profitability of organic farming; collective forms of farming. **Schlecht (Nat Sci):** sustainability of livestock husbandry; environmental effects of animal keeping and their avoidance: a) GHG emissions and environmental pollution from animal holdings; b) overgrazing.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Lecture notes and reading materials distributed during the module;

Bell, S. & Morse, S., 2003. Measuring sustainability: learning by doing; Earthscan, London, UK. Bell, S. & Morse, S., 2008. Sustainability indicators: measuring the immeasurable? Earthscan, London, UK.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I13: Issues and methods in food business research	6 C 4 WLH
Learning outcome, core skills: The aims of the module are: • To develop students' ability to analyse and evaluate management practices and discourses in the food sector according to multiple theoretical perspectives; • To appreciate contrasting perspectives; • To develop students' critical skills and to enable them to engage with current debates in food business research; • To introduce students to empirical research in the field of international food business; • To support students in the development of their dissertation and project work (e.g. constructing research questions about food business).	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Issues and methods in food business research (Seminar) *Contents*: In this module, we address the more contemporary debates and developments of food business theory and research. We explore, examine and discuss contrasting perspectives of contemporary issues of food business, from a practical and policy-oriented perspective, as well as from a theoretical point of view. We also investigate the research methods applied in food business studies. A particular interest lies in the advancement of knowledge in responsible and sustainable food business.	
Examination: Presentation (45 minutes) with hand-out (max. 2 pages) (50%) and written report (max. 4 pages, 50%) **Examination requirements:** Students should be able to critically engage in current debates about food business (with a particular focus on responsible and sustainable business) and reflect on the usefulness and limitations of methods applied in food business research. Students should demonstrate that they are able to identify, explain and discuss the key aspects of the literature investigated.	6 C
Examination requirements: ECTS-Bedingungen de	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Alle Herzig, Christian, Prof. Dr.
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	
Maximum number of students: 35	

Additional notes and regulations: Lectures and group discussion

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P01: Ecology and agroecosystems**	6 C 4 WLH

Learning outcome, core skills: Students are able to define site-specific conditions of sustainability, identify key constraints to the productivity and sustainable use of agro-ecosystems, assess the scope of human (management) interventions, determine the causes of productivity decline and chose approaches to strengthen sustainability	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Ecology and agroecosystems (Lecture, Seminar) *Contents*: Case-study based analysis and discussion of ecological framework conditions (limitations) in different arid and sub-humid agro-ecosystems of tropical and temperate zones with a particular focus on marginal soils and/or difficult infrastructural conditions where effective nutrient cycling, integration of cropping and animal husbandry systems as well as the use of biodiversity for income generation at the farm level is of particular importance. The potential/role of organic agriculture will be discussed and a more general discussion of the potential of organic agriculture to strengthen the resilience of agro-ecosystems will be presented.	4 WLH
Examination: Oral exam (approx. 15 minutes, 60%) and presentation (approx. 20 minutes, 40%) **Examination requirements:** Students should be able to explain the function and biophysical limits of (sub)tropical agro-pastoral land use systems, to justify the need to establish interdisciplinary approaches and to describe current research methods in land use systems analysis.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in plant, soil and animal science, willingness to analyse agro-ecosystems quantitatively
Language: English	**Person responsible for module:** Prof. Dr. Andreas Bürkert
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Gliessman, S.R. 1998: Agroecology: ecological processes in sustainable agriculture. Ann Arbor Press, Michigan, USA.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P04: Plant nutrition in the tropics and subtropics	6 C 4 WLH
Learning outcome, core skills: Based on knowledge of principles of plant nutrition the students are able to find solutions for specific problems with regard to plant nutrition in the tropics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Plant nutrition in the tropics and subtropics (Lecture, Practical course) *Contents*: Lecture: Dynamics and availability of nutrients in acid, highly weathered soils, alcaline soils, and paddy soils. Nutrient deficiency and toxicity in plants. Problems with Al-toxicity and salinity. N-fertilization, N2-fixation. Nutrient cycling in special cropping systems like shifting cultivation, intercropping, agroforestry, paddy rice. Laboratory course: Investigations about P availability, P uptake, and P efficiency mechanisms. Performing a complete experiment including the necessary chemical analyses and data evaluations.	4 WLH
Examination: Oral examination (approx. 20 minutes) **Examination prerequisites:** Oral exam (20 minutes) **Examination requirements:** Knowledge of basic principles of plant nutrition and tropical plant nutrition in particular. Knowledge of cropping systems and their influence on soil fertility and nutrient cycles. Special aspects of plant nutrition in paddy rice.	6 C

Admission requirements: Prerequisite for admission to examination is the attendance at the laboratory course.	**Recommended previous knowledge:** Baisc knowledge in soil and plant sciences
Language: English	**Person responsible for module:** Dr. Bernd Steingrobe
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:
Literature:

Will be given during the lecture.

Laboratory course: blocked in a week at the beginning of the semester break.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P05: Organic cropping systems under temperate and (sub)tropical conditions**	6 C 4 WLH

Learning outcome, core skills: Students are able to describe the principles and functions of agro-ecosystems, understand nutrient cycles and options for their improvement as an important basis of organic farming, evaluate systems of land use with a particular focus on organic modes of production and their role in agro-ecosystems, assess the role of livestock for nutrient cycling and with respect to the conservation of plant and animal biodiversity in (sub-)tropical settings.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Organic cropping systems under temperate and (sub)tropical conditions (Lecture, Excursion, Seminar) *Contents*: Visits of organic farms; case studies of livestock-oriented organic farming under different environmental conditions and constraints; development, evaluation and comparison of land use management systems under diverse natural, economic and socio-cultural conditions; nutrient cycling in plant-animal systems; site-specific contributions of legumes to N supply; P availability, P recycling and use of rock phosphates; modes of P supply in farming systems; EC, Australian, Japanese and North American regulations for organic farming – problems and opportunities.	4 WLH
Examination: Oral exam (ca. 15 minutes, 75%) and presentation (15 minutes, 25%) **Examination requirements:** Each individual test has to be passed. Kenntnisse von ökologischen Pflanzenanbausystemen, vom Management von Nährstoffkreislaufsystemen, von gezielter Nutzung von Leguminosen für die standortgerechte N-Versorgung sowie Kenntnisse über die Grundlagen der P-Verfügbarkeit, der P-Rückführung und der Nutzung von Rohphosphaten. Wissen über die Möglichkeiten der P-Versorgung in verschiedenen Anbausystemen, über die Unterschiede und Probleme bei den Ökostandards in EU, Japan, Australien und USA sowie Wissen über den Beitrag der Tierhaltung zur Nachhaltigkeit ökologischer Anbausysteme.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in plant, soil and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Andreas Bürkert
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

not limited	

Additional notes and regulations:

Literature:

Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Willer, H. et al. 2008: The World of Organic Agriculture - Statistics and Emerging Trends 2008, IFOAM, Bonn, Germany.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P06: Soil and water**	6 C 4 WLH
Learning outcome, core skills: Students understand soil - water - plant relations and basic soil physical, soil hydrological and soil (micro)biological processes. They are able to critically evaluate soil and water problems and limits of soils as a natural resource and judge soil management options for sustainable land use.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Soil and water (Lecture, Exercise) *Contents*: Fundamental physical and hydrological processes; Soil water storage and transport; Physicochemical properties, Soil water in relation to mechanical processes (e.g. workability, deformation, soil strength); Soil – Water - Plant Relations (root water uptake, root growth, transpiration, soil-plant-atmosphere continuum); Field water cycle and management effects (e.g. mulching, tillage, irrigation); Irrigation principles and practices; Soil degradation and conservation (e.g. soil salinisation, compaction, acidification, contamination); Edaphon and its functions; Mycorrhiza; Rhizobia; Methods in soil biology; Indicators of soil fertility; Turnover of the soil microbial biomass; Habitat protection and ecotoxicology; Soil biology and fertility of tropical soils.	4 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Kenntnisse über die Bodendegradation und Bodenerhaltung, das Wassermanagement in nationalem und internationalem Kontext, die Bodenqualität, Prozesse und Funktionen sowie über die Wassergewinnung und –verteilung, Flächenbewässerung, Beregnung, Tropfbewässerung.	6 C

Admission requirements: none	**Recommended previous knowledge:** Fundamentals of soil science; Module Soil and Plant Science or equivalent.
Language: English	**Person responsible for module:** Peth, Stephan, Prof. Dr.
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

N.C. Brady & R. R. Weil, 2008. The Nature and Properties of Soils. 14th ed., Pearson International Press; Hillel, D. (1998): Environmental Soil Physics. Academic Press; Jury, W. & Horton, R. (2004): Soil Physics.

Wiley & Sons; Lal, R. & Shukla, M.K. (2004): Principles of Soil Physics, Marcel Dekker Inc.; Ehlers, W. & Goss, M. (2003): Water Dynamics in Plant Production, CABI Publishing; Kirkham, M. B. (2005): Principles of Soil and Plant Water Relations, Elsevier; Coyne, M. S. (1999). Soil microbiology: an exploratory approach, Thomson Press; Paul, E.A., Clark, F.E. (1996). Soil microbiology and biochemistry, 2nd ed., New York Academic Press.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P07: Soil and plant science**	6 C 4 WLH
Learning outcome, core skills: Bridging module for students lacking basic knowledge in some agronomy disciplines. With the help of lectures and reading materials students will be enabled to fill in gaps and get updated on state-of-the art knowledge with a special focus on questions pertinent to organic agriculture. Students, having taken this module, will be able to follow advanced courses in the above fields.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Soil and plant science (Lecture, Seminar) *Contents*: Influence of soil formationprocesses on physical properties (texture, soil water, pore space), chemical properties (buffering, exchange capacity, nutrients), and biological properties (organic matter, edaphon), soil formation and classification. Nutrient availability and and nutrient mobilization under conventional and organic agricultural conditions. Major and minor nutrients and food quality.Plant breeding goals for different agricultural systems. Plant morphology, genetics and breeding: principles of plant domestication and use, characterization and evaluation, use of genetic resources in plant breeding, genetic basis for plant breeding Genetics of host-parasite interactions, epidemiology and plant defence. Insect physiology and ecology. Spezifische allgemeine und wissenschaftliche Artikel, die sich mit dem Zielland der Exkursion befassen werden über eine E-Learning Plattform zur Verfügung gestellt	4 WLH
Examination: Written exam (120 minutes) or oral exam (ca. 20 minutes) **Examination requirements:** Fundamentals of soil science: Physical properties (texture, soil water, pore space), chemical properties (buffering, exchange capacity, nutrients), biological properties (organic matter, edaphon), soil formation and classification. Plant nutrition: Role of major and minor elements in plants, nutrient availability and nutrient mobilisation, plant nutrients and food quality Plant breeding and genetics: plant morphology, genetics and breeding: principles of plant domestication and use, characterization and evaluation, use of genetic resources in plant breeding, genetic basis for plant breeding. Plant protection: principles of plant pathology and entomology, genetics of plant diseases, epidemiology, plant defence mechanisms; insect physiology and ecology	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Helmut Saucke
Course frequency:	**Duration:**

each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Brady, N.C. 1990: The nature and properties of soils. 10th edition, Prentice Hall; Marschner, H. 1995: Mineral Nutrition of Higher Plants, Academic Press, New York; Sanchez, P. 1976: Properties and Management of Soils of the Tropics, Wiley, New York; van Wyk, B.E. 2005: Food Plants of the World. Briza Publication, Pretoria; Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf, Weikersheim, Germany; Agrios, G.N. 2005: Plant Pathology, 5th edition, Academic Press, New York; Pedigo, L.P. 2002: Entomology and Pest Management, 4th edition, Macmillan Pub Co.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P08: Pests and diseases of tropical crops**	6 C 6 WLH
Learning outcome, core skills: Students should become familiar with the causes of diseases (abiotic & biotic diseases), with the taxonomy of disease agents (bacteria, fungi, virus) and insect pests, with basics of integrated pest management (approaches, economic threshold, epidemiology), and biological, cultural control (cultivars, crop rotation, planting term, manual control), and chemical control options (toxicology, fungicides, insecticides) of the main crops in subtropical and tropical regions	**Workload:** Attendance time: 84 h Self-study time: 96 h
Course: Pests and diseases of tropical crops (Lecture, Seminar) *Contents*: Pests and diseases of selected crops are treated together for each crop including approaches to integrated control. The following crops will be presented: rice, maize, cotton, cocoa, coffee, cassava, phaseolus beans, bananas, and others. For each crop, a short introduction to botanical and agronomic features (as far as they concern disease or pest control) is given, together with an overview of the main diseases world-wide. The economic importance of diseases and pests in different geographical areas is discussed. The most important diseases and pests of die crop are treated in detail and die possibilities for integrated control are discussed. Short introductions (reviews) on basic subjects of plant protection are given, these include: causes of diseases (abiotic & biotic diseases), taxonomy of disease agents (bacteria, fungi, viruses) and insect pests, integrated pest management (approaches, economic threshold), biological control (diseases, pests), cultural control (varieties, crop rotation, planting term, manual control), and chemical control (toxicology, fungicides, insecticides). Students will give seminars on related topics. Vorlesungsbasierte Literatur	6 WLH
Examination: Written exam (60 minutes, 67%) and presentation (ca. 20 minutes, 33%) **Examination prerequisites:** Seminar speech **Examination requirements:** Knowledge on the most important pests and diseases of tropical and subtropical crops; chemical and biological control options, phytosanitary approaches, and sustainable cropping systems for tropical crops.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) in agricultural entomology, plant diseases and plant production
Language: English	**Person responsible for module:** Prof. Dr. Stefan Vidal
Course frequency:	**Duration:**

each summer semester; Göttingen	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations: **Literature:** Lecture based materials; details provided during lectures.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P10: Tropical agro-ecosystem functions**	6 C 4 WLH

Learning outcome, core skills: Knowledge of the processes of soil degradation as well as of the measures for their control or prevention in selected land use systems of the tropics and subtropics; knowledge of ecological system functions and their synthesis in agronomic concepts for the adaptation to unfavourable climatic and pedological conditions in the tropics and subtropics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Tropical agro-ecosystem functions (Lecture, Seminar) *Contents*: Introduction to and overview of agronomy-based land use systems in the tropics and subtropics taking into account ecological points of view. Analysis of the sustainability of plant production under special consideration of the physical, chemical and biological soil quality as well as the efficient water use in the seasonal tropics.	4 WLH
Examination: Presentation (ca. 30 minutes, 50%) and oral exam (ca. 30 minutes, 50%) **Examination requirements:** Knowledge about the processes of soil degradation and the measures taken to control or prevent in selected land use systems in the tropics and subtropics; knowledge of ecosystem functions and their synthesis in agronomic concepts to adapt to unfavorable climatic and pedological conditions in the tropics and subtropics.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil and plant sciences
Language: English	**Person responsible for module:** Dr. sc. agr. Ronald Franz Kühne
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Additional notes and regulations: **Literature:** Lecture notes and handouts, selected chapters from textbooks; copies of PowerPoint presentations

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P13: Agrobiodiversity and plant genetic resources in the tropics**	6 C 4 WLH
Learning outcome, core skills: Students are able to understand the role of agrobiodiversity in tropical agro-ecosystems, to present approaches of functional biodiversity analysis and to discuss the needs and strategies of on-farm (in situ) and off-farm conservation of plant genetic resources.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Agrobiodiversity and plant genetic resources in the tropics (Lecture, Seminar) *Contents*: Case-study based analysis of the role of biodiversity for selected crops in different agro-ecosystems from the arid to the humid climate zones; importance of biodiversity for the stability / sustainability of smallholder (subsistence) versus commodity-oriented commercial agriculture in the Tropics, assessment and utilization of diversity, principles and practices in conservation of genetic resources, role of homegardens and indigenous wild fruit trees for in situ conservation of biodiversity, causes and consequences of genetic erosion, approaches of germplasm collection.	4 WLH
Examination: Oral exam (about 15 minutes, 60%) and presentation (about 20 minutes, 40%) **Examination requirements:** Students should be able to understand the role of agrobiodiversity in tropical agroecosystems, to present basic approaches to functionally analyse biodiversity and to discuss the need of and strategies for *in* and *ex situ* conservation of genetic resources.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in plant and soil sciences
Language: English	**Person responsible for module:** Prof. Dr. Gunter Backes
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Eyzaguirre, P.B., Linares, O.F. 2004: Home gardens and agrobiodiversity. Smithsonia

Books, Washington, USA; Wood, D., Lenne, J.M. 1999: Agrobiodiversity: Characterization, utilization and management. CABI Publishing, Wallingford, UK.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P15M: Methods and advances in plant protection	6 C 4 WLH
Learning outcome, core skills: Students are able to critically evaluate published results and apply this knowledge to actual problems in the field. They are also able to deal with problems in the field: Identification and measurements, design of experimental and analytical approaches to problems.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Methods and advances in plant protection (Lecture, Excursion, Exercise) *Contents*: Advanced course in plant pathology and entomology. Methodology and evaluation methods in plant protection. Case studies of specific plant protection issues in organic farming in the form of lectures, seminars and practical courses.	4 WLH
Examination: Written exam (120 minutes) or oral exam (ca. 20 minutes) (70%) and work reports (max. 3 pages) or seminar speech (ca. 10 minutes) (30%) **Examination requirements:** Advanced knowledge in plant protection (Entomology and Pathology) Methodology and evaluation methods in plant protection based on case studies.	6 C

Admission requirements: Introductory course in plant protection (entomology and pathology, at least 6 ECTS or equivalent) or bridging module M.SIA.P07 Soil and Plant Science	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Maria Renate Finckh
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:

Agrios, G.N. 2005: Plant Pathology, 5th edition Academic Press, New York; Pedigo, L.P. 2002: Entomology and Pest Management, 4th edition, Macmillen Pub Co.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P17M: Nutrient dynamics: long-term experiments and modelling	6 C 4 WLH
Learning outcome, core skills: Students are able to use established models and the statistical software R for a study and description of ecological processes in arable soils. Based on their understanding of soil nutrient dynamics they are able to evaluate and critically assess the significance of long-term and laboratory experiments for studying C, N and P dynamics and to consider all influencing variables.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Nutrient dynamics: long-term experiments and modelling (Lecture, Exercise) *Contents*: • Description of the dynamics of C, N and P (forms, transformations and availability) in arable soils • Presentation of the results of existing long-term experiments with emphasis on the variables and variants influencing these results • Introduction to modelling, including statistical modelling • Application of the statistical software R for a description of C dynamics (linear and non-linear regression) • Modelling of the turnover of soil organic matter and soil nitrogen using the models "Rothamsted Carbon Model" and "DNDC"	4 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Knowledge of biological and chemical processes in soils and of the C and N dynamics. Basic knowledge of modelling, including statistical modelling, and the structure of the Rothamsted Carbon Model and the DNDC model. Verständnis bodenkundlicher Prozesse, insbesondere der C- und N-Formen und Kreisläufe, Grundverständnis der Modellierung (einschließlich statistischer Modellierung), Kenntnisse der Modelle Rothamsted Carbon Model und DNDC.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil and plant sciences
Language: English	**Person responsible for module:** Prof. Dr. Bernard Ludwig
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 20	

Additional notes and regulations:

Literature:

Blume H.-P. et al. 2002: Lehrbuch der Bodenkunde, 15. Auflage, Spektrum, Heidelberg; Merbach, W. et al. 2000: The long-term fertilization experiments in Halle (Saale), Germany - introduction and surveys. Journal of Soil Science and Plant Nutrition 163. 629-638; Coleman, K., Jenkinson, D.S 1996: RothC-26.3 - A model for the turnover of carbon in soil. In: Powlson, D.S., Smith, P., Smith J.U. (eds.): Evaluation of soil organic matter models. Springer, Berlin; Li, C. 1996: The DNDC model. In: Powlson, D.S., Smith, P. Smith, J.U. (eds.) 1996: Evaluation of Soil Organic Matter Models. Springer, Berlin

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P19M: Experimental techniques in tropical agronomy	6 C 4 WLH
Learning outcome, core skills: Knowledge of the botanical, ecological and agronomic facts of the introduced crop plants and multiplication techniques, scientifically correct interpretation and discussion of results from a greenhouse experiment, limitations and potentials of the interpretation of measuring procedures for the description of physiological state variables in tropical crop plants.	**Workload:** Attendance time: 60 h Self-study time: 120 h
Course: Experimental Techniques in Tropical Agronomy (Lecture, Exercise, Seminar) *Contents*: Principles and practice of vegetative and generative propagation techniques in the greenhouse of the division. Introduction to statistical experimental design and analysis of greenhouse experiments. Theory and practice of eco-physiological measurement methods for the water balance and status, as well as gas exchange / photosynthesis rates in tropical crop plants **Literatur** Kopien von Powerpoint-Präsentationen, ausgewählte Kapitel von Lehrbüchern.	4 WLH
Examination: Presentation (ca. 30 minutes, 50%) and protocol (max. 20 pages, 50%) **Examination requirements:** Knowledge of botanical, ecological and agronomic facts of the presented crop plants; scientifically correct planning, implementation, evaluation, description and discussion of the results of a greenhouse experiment; limits and possibilities of interpretation of measurement methods for describing the physiological state variables of tropical crop plants.	6 C

Admission requirements: M.SIA.P12	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of plant sciences
Language: English	**Person responsible for module:** Dr. sc. agr. Ronald Franz Kühne
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Additional notes and regulations:
Literature:

Copies of PowerPoint presentations, selected chapters from textbooks

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.P21: Energetic use of agricultural crops and Field forage production**	6 C 4 WLH
Learning outcome, core skills: Based on the data presented, students are able to identify and calculate potentials and limits of energy and raw material production from renewable plant resources. Furthermore students are able to classify and to assess the importance of field forage production for organic cropping systems.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Energetic use of agricultural crops and Field forage production (Lecture, Excursion) *Contents*: Management of agricultural crops for energetic use. Energy scenario and potentials, emission of greenhouse gases, sources of energy from biomass and waste material, selecting and processing biomass as a fuel. Biogas, fermentation process and plant technology. Gasification, Fischer-Tropsch-Process. Benefits and restrictions by the replacement of fossil fuel-based materials through biomass-based products. *The importance of field forage production (ffp) for organic cropping systems; basics of ffp – plant species; integration of ffp in crop rotation systems ;environmental impact of ffp, quality aspects; nutrient-dynamics*	4 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Basic and theme specific deepened knowledge on the energetic use of agricultural biomass and on the presented aspects of field forage production.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowlege in soil and plant sciences, physics and chemistry
Language: English	**Person responsible for module:** Prof. Dr. Michael Wachendorf
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations:

Literature:

Klass, D. 1998: Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press; Sims, R. 2002: The Brilliance of Bioenergy. James & James, London, UK; Rosillo-Calle, F. 2007: The Biomass Assessment Handbook. Earthscan; London, UK

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P22: Management of tropical plant production systems**	6 C 4 WLH

Learning outcome, core skills: Knowledge of botanical, ecological and agronomic facts of presented crops and cropping systems. The students should be able to classify crops and cropping systems in relation to site conditions and undertake system-orientated evaluation of sustainable production.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Management of tropical plant production systems (Lecture) *Contents*: Presentation of the most important crops with respect to: botany, morphology, origin, climatic and ecological requirements, crop production, harvest procedure, significance in local farming systems, utilisation as food, feed, raw materials and as bioenergy source. Discussion of specific cropping systems in the tropics and subtropics and specific management systems for the sustainable improvement of productivity. **Literatur** Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf. Weikersheim, Germany; lecture notes	4 WLH
Examination: Written exam (90 minutes) or oral exam (ca. 30 minutes) **Examination prerequisites:** Crops and production systems in the tropics **Examination requirements:** Knowledge of botanical, ecological and agronomic facts of the presented crops and cropping systems. Knowledge of the assignment of crops and cropping systems to different site conditions, as well as system-oriented evaluation of sustainable production at selected sites.	6 C

Admission requirements: Basic knowledge on plant production (BSc-level)	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Reimund P. Rötter
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:
exam on the first examination, oral exam on the second examination

Literature:

Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf. Weikersheim, Germany; lecture notes

Georg-August-Universität Göttingen Module M.WIWI-BWL.0004: Financial Risk Management	6 C 4 WLH
Learning outcome, core skills: After a successful completion of the course students should be able to • understand and explain how risk management is related to other issues in corporate finance. • critically assess different motivations for corporate risk management. • understand and critically assess different risk measures and how they are applied in practice. • understand and explain how international risks can be managed and how the management of international risks is related to various economic parity conditions. • understand, analyze and critically apply measures and methods to manage interest rate risk. • understand, analyze and critically apply measures and methods to manage credit risk. • understand, analyze and critically apply hedging strategies for commodity price risk.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Financial Risk Management (Lecture)** *Contents*: 1. Introduction 2. Risk Management: Motivation and Strategies 3. Managing International Risks 4. Managing Interest Rate Risk 5. Managing Credit Risk 6. Managing Commodity Price Risk Parts of the material covered by the lectures will be transmitted via recordings that students have to work through on their own. Parts of the contact hours during lectures will be used by the students to discuss open issues and to work on specific cases and applications of the main concepts.	2 WLH
2. Financial Risk Management (Tutorial) *Contents*: In the accompanying practice sessions students deepen and broaden their knowledge from the lectures.	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: • Demonstrate a profound knowledge of how risk management is related to other issues in corporate finance. • Document an understanding of viable reasons for corporate risk management and how corporate risk management can create value. • Demonstrate the ability to analyze and apply different risk measures.	

• Show a profound understanding of methods and techniques used to manage international risks, interest rate risk, credit risk, and commodity price risk.	

Admission requirements: none	**Recommended previous knowledge:** Modul "Finanzwirtschaft"
Language: English	**Person responsible for module:** Prof. Dr. Olaf Korn
Course frequency: Generally every winter semester during the first half of the semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0018: Analysis of IFRS Financial Statements**	6 C 4 WLH
Learning outcome, core skills: The aim of this course is to familiarize students with contemporary methods of financial statement analysis and accounting-based valuation. Special emphasis will be put on (1) the interrelation between valuation theory and accounting, (2) relevant characteristics of financial statements prepared on the basis of International Financial Reporting Standards (IFRS), and (3) application of the valuation and analysis framework to real world cases and examples. The course will discuss several approaches to valuation of equity and debt investments and their respective merits. Based on the concept of accounting-based valuation, an analytical framework for analysis of financial statements will be developed, with an emphasis on ratio analysis of profitability and growth. The role of accounting and accounting quality in general, and with respect to International Financial Reporting Standards (IFRS), will be assessed throughout the course. Successful participants of this course are expected to be familiar with contemporary methods of equity valuation, the use of financial statement information to that end, and the application of that knowledge to real-world valuation cases.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Analysis of IFRS Financial Statements (Lecture)** *Contents*: *I. Foundations of Financial Statement Analysis* *II. IFRS Financial Statements* *III. Valuation Methods* *IV. Analysis of Financial Statements* *V. Forecasting and Valuation Analysis*	 2 WLH
2. Analysis of IFRS Financial Statements (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: In order to accomplish successfully this course, students are expected to be familiar • with contemporary methods of equity valuation, • the use of financial statement information to that end, and • the application of that knowledge to real-world valuation cases.	

Admission requirements: none	**Recommended previous knowledge:** Modul "Rechnungslegung"
Language: English	**Person responsible for module:** Prof. Dr. Jörg-Markus Hitz
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0020: Risk Management and Solvency**	6 C 2 WLH
Learning outcome, core skills: • Knowledge and understanding of the functions and elements of a risk management system, of the risk potentials and its valuation of an insurance company; • Knowledge of the legal requirements regarding risk management and solvency, especially Solvency II; • Knowledge of the relevant techniques used in risk management of an insurance company (stress tests, ALM, Embedded Value, actuarial analysis, Value Based Management); • Understanding of the relevant methods used in the balance sheet of an insurance company (HGB, IFRS, solvency balance sheet); • Ability to develop simple task settings independently with regard to risk management and solvency	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Risk Management and Solvency (Lecture) *Contents*: • Role and components of a risk management system • Legal requirements: MaRisk, stress tests, actuarial reporting, market consistent valuation (IFRS) • Solvency requirements (Solvency I, Solvency II) • Value Based Management, Embedded Value, Asset Liability Management (ALM)	2 WLH
Examination: Written examination (120 minutes)	6 C
Examination requirements: • Document a knowledge and understanding of the functions and instruments of risk management and of the valuation of risk potentials; • Demonstrate a knowledge and understanding of quantitative and qualitative requirements of the solvency regime; • Demonstrate a knowledge and understanding of market consistent valuation within solvency, HGB,IFRS; • Demonstrate the ability for simple calculations with regard to risk management and solvency.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Martin Balleer
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0075: Pricing Strategy**	6 C 4 WLH
Learning outcome, core skills: After successful attendance the students should be able to implement the most important determinants of pricing policy and pricing management, as well as to apply selected marketing techniques, marketing strategies, psychological and economic theories for the analysis of optimal pricing strategies. Further, the students learn to investigate the pricing strategy from a B2B and B2C perspective, completed on case studies and caselets.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Pricing strategy (Lecture) *Contents*: • Introduction to pricing strategy • Value creation • Market segmentation and pricing structure • Price adjustment • Pricing strategy and price level • Cost and financial analysis The course's conveyed theoretical knowledge is practiced and consolidated with the help of case studies	2 WLH
2. Pricing strategy (Exercise)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Tactics of pricing policy, pricing strategies, Calculation of the economic value of products, pricing mechanisms, financial analysis, pricing mechanisms in competition	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yasemin Boztug
Course frequency: every second winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0109: International Human Resource Management**	6 C 3 WLH
Learning outcome, core skills: Students get insights into major topics of Human Resource Management (HRM) in an international context. The course will introduce the context international managers need to consider, e.g. cultural differences, and major HRM functions, e.g. global staffing. The course consists of lectures and tutorials. Lectures will provide an introduction to relevant aspects of HRM in an international context. Tutorials will help students to discuss and transfer knowledge between theory and practice.	**Workload:** Attendance time: 42 h Self-study time: 138 h
Courses:	
1. International Human Resource Management (Lecture)	2 WLH
2. International Human Resource Management (Tutorial)	1 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Demonstrate a profound knowledge of and ability to manage challenges in international HRM.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0110: Strategic Human Resource Development	6 C 2 WLH

Learning outcome, core skills: Students will understand the relationship between strategy and human resource development and the different models as well as tasks and phases of human resource development. By using an innovative approach the students will be enabled to plan and evaluate measures of human resource development in practice. In the past we have covered e.g.: • Strategic approaches to human resource development • Didactics and methods of training • Competency management • Qualitative and quantitative analysis of training needs and diagnostics • Forms of human resource development • Ensuring Transfer • Quality management and controlling • Case: Design of a development measure • Leadership Development • Talent management • Coaching/ Mentoring • Development of (leadership-)teams • Organizational development	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Strategic Human Resource Development (Seminar) *Contents*: To achieve strategic goals companies need to recruit, retain and develop the right employees. In this regard the seminar focuses on strategic human resource development as one important driver of successful strategy implementation. The seminar provides an overview of the objectives, phases and measures of personnel and leadership development and introduces the students to different methods of training. The seminar is praxis-oriented and fosters individual application and transfer. It has a significant practical element as students will carry out their own training designs and present them to the class. Therefore, in the beginning, basics of human resource development will be covered by the lecturer and an overview of training methods will be given. Building on this, groups of students will present their own topic.	2 WLH

Examination: Presentation (approx. 60 minutes) and written elaboration (max. 20 pages) **Examination requirements:** To pass the course students have to write a seminar paper and give a presentation. They have to prove, that they are able to systematically apply their knowledge of training design. Attendance is mandatory.	6 C

Admission requirements:	**Recommended previous knowledge:**
none	Basic knowledge of Human Resource Management

Language: English	**Person responsible for module:** Anna Katharina Bader
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0111: Selected Topics in Asian Business and Management**	6 C 2 WLH
Learning outcome, core skills: After attending this seminar, students will be able to analyse contemporary Asian business and management issues. The course will also give guidance on academic writing.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Selected Topics in Asian Business and Management (Seminar) *Contents*: The rapidly growing presence of Asian countries in the modern economy and intensifying business ties between Europe and Asia necessitate thorough academic research and understanding of Asian business and management. The seminar will place particular focus on selected Asian countries, e.g. China, Japan, South Korea, and Indonesia. It will cover research fields related to Asian business and management issues (e.g. market entry, employee retention, expatriates, M&A). This seminar will also provide a platform for interdisciplinary approaches and comparative research of respective countries.	2 WLH
Examination: Presentation (approx. 30 minutes) and term paper (max. 7000 words) **Examination requirements:** Demonstrate profound knowledge of a specific topic in Asian business and management. Present and write a research paper.	6 C

Admission requirements: none	**Recommended previous knowledge:** Asian Business and Management (lecture)
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0112: Corporate Development**	6 C 4 WLH
Learning outcome, core skills: Students... • are familiar with different perspectives and drivers of corporate development. • can identify and define options of action and strategies for the development of companies and the conditions necessary to obtain success. • know tools and measures important for the control of innovative activities in companies. • apply the tools and concepts that have been acquired in order to analyze as well as to tackle case studies. • are able to deal with the ambiguity of real situations and make reasonable decisions.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Corporate Development (Lecture) *Contents*: This course introduces models and strategies of corporate development: • Core topics and practical relevance of corporate development • Models and processes of corporate development • Strategies of corporate development, direction of growth and shift of boundaries of companies • Innovation strategies and management	2 WLH
2. Corporate Development (Exercise) *Contents*: The tutorial complements the lecture. Students learn how to apply tools and concepts in order to analyze and tackle case studies and how to deal with the ambiguity of real situations. *Course frequency:* jedes Sommersemester	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Demonstrate a profound knowledge of and ability to manage challenges in corporate development.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Indre Maurer
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0115: Human Resource Management Seminar**	6 C 2 WLH
Learning outcome, core skills: In this seminar, students should independently and systematically work on a current topic in human resource management (HRM). Students can select among different topics regarding HRM and are supposed to prepare a research paper.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Human Resource Management Seminar (Seminar) *Contents*: The objective of this seminar is to encourage students to approach a current HRM topic from a scientific perspective. Students can also improve their communication and presentation skills while discussing the work of their peers and presenting their own research project. This seminar might further prepare students to write a master thesis. The seminar paper can be written in English or German.	2 WLH
Examination: Presentation (approx. 30 minutes) and term paper (max. 7000 words) **Examination requirements:** Demonstrate a profound knowledge of a specific topic in HRM and ability to develop theoretical and practical implications.	6 C

Admission requirements: none	**Recommended previous knowledge:** Modul "International Human Resource Management", Modul "Survey Research"
Language: German, English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0116: Asian Business and Management	6 C 2 WLH
Learning outcome, core skills: Due to the rapid growth of Asian countries in the modern economy and intense business ties between Europe and Asia knowledge about Asian business and management has become important. This course aims at increasing the understanding of Asian business and management. Students will learn about the economic environments, success factors of major Asian companies and how foreign companies and managers can succeed in selected Asian countries, e.g. China, South Korea, and Japan.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Asian Business and Management (Lecture)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Demonstrate knowledge of Asian business and management.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0118: Survey Research	6 C 2 WLH
Learning outcome, core skills: This seminar provides an overview of the whole process of a survey research project, including survey design, implementation, and statistical analyses. Students will learn theoretical foundations as well as practical application of statistical methods, which provide them the knowledge to conduct and analyze survey results by using statistical software, such as SPSS and AMOS. The seminar should prepare students to conduct empirical research projects, e.g. as part of a master thesis, according to scientific standards.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Survey Research (Seminar)	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 8000 words)	6 C
Examination requirements: To pass the course, students have to write a seminar paper and give a final presentation. They have to demonstrate that they are able to systematically apply their knowledge of survey research methods.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0122: Cross-Cultural Management	6 C 2 WLH
Learning outcome, core skills: Cross-Cultural Management is an interdisciplinary field of study which aims to improve communication, management and interaction of people from different cultures. Through the increased globalization of the economy, cross-border ventures, global relocations and the increased use of e-commerce, many businesses are finding that managing cultural differences can be a key factor in obtaining their objectives. The lecture itself deals with several key competencies and methods the students will need when working with/in different cultures.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Cross-Cultural Management (Lecture)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Proof of knowledge of the various characteristics, methods and problems in cross-cultural management.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Jaime Bonache
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0123: Tax Transfer Pricing**	6 C 2 WLH

Learning outcome, core skills: Having attended this lecture series the students • know the basic fundamentals of international tax transfer pricing including the legal basis for adjusting income, • are familiar with the OECD transfer pricing guidelines and selected German equivalents, • know the methods to determine transfer prices, • know possibilities and limitations of profit shifting via transfer pricing, • gain an insight into the extent of profit shifting via transfer pricing by examining relevant empirical and experimental literature, • are competent in using different methods of calculating transfer prices for tax purposes, • are in a position to assess the appropriateness of transfer pricing mechanisms and to apply transfer pricing methods.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Tax Transfer Pricing (Lecture) *Contents*: The lecture series gives an overview of the fundamentals of transfer pricing. It is the aim of the series that students gain understanding of the institutional background of international tax transfer pricing taking into account the allocation of functions, assets and risks among affiliated companies. Students should also learn about the opportunities and limitations of tax planning via transfer pricing. Furthermore, the series provides insights into empirical and experimental studies dealing with profit shifting via transfer pricing.	2 WLH

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Evidence of knowledge on institutional framework conditions concerning tax transfer pricing, tax planning on the basis of transfer pricing, and limitations to profit shifting via transfer pricing.	6 C

Admission requirements: none	**Recommended previous knowledge:** Modul "Grundlagen der internationalen Unternehmensbesteuerung" (M.WIWI-BWL.0105)
Language: English	**Person responsible for module:** Prof. Dr. Andreas Oestreicher
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 32	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0125: International Organizational Behavior	6 C 2 WLH
Learning outcome, core skills: This seminar is an inter-disciplinary examination of the international dimensions of organizational behavior. The course content includes topics such as cross-cultural management, cross-cultural communication, and global aspects of leadership, motivation, team management, and decision-making. The seminar will deal with topics within the field of „Organizational Behavior” in an international context. The course will enable the students to develop transferable skills suitable for engaging with the challenges of employment/self-employment within the global economy. Comprehensive understanding of the processes of globalization in the 21st century and their implications for the business person. They will gain comprehensive knowledge and skills for successful careers in multinational corporations, non-governmental organizations, and academic institutions	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: International Organizational Behavior (Seminar)	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 8.000 words)	6 C
Examination requirements: Demonstration of in-depth knowledge regarding the "International Management" research and development and of theoretical and practical implications obtaining from your own research project.	

Admission requirements: none	**Recommended previous knowledge:** Lecture “Organizational Behavior” Lecture „International Human Resource Management“
Language: English	**Person responsible for module:** Prof. Jaime Bonache
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0126: Consumer Science & Public Policy**	6 C 2 WLH
Learning outcome, core skills: After successful attendance the students should understand the public policy implications of consumer behavior. Moreover, they should be able to craft concrete policy suggestions based on recent consumer research.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Consumer Science & Public Policy (lecture) *Contents*: The course consists of two parts, a lecture and a presentation of a term paper. Lecture content: • Introduction to consumer science & public policy • Transformative consumer research • Nutrition and health • Consumer vulnerability and protection • Ethics and social responsibility	2 WLH
Examination: Written examination (45 minutes) **Examination requirements:** Health marketing, food marketing, ethics, consumer protection, transformative consumer research	3 C
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 12 pages) **Examination prerequisites:** regular participation **Examination requirements:** The term paper will contain a summary of selected research on a given topic (consumer science part). Moreover, participants are expected to critically discuss current policies in consumer science and to formulate additional public policy implications. The papers will be presented in class.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yasemin Boztug Dr. Steffen Jahn
Course frequency: every winter term	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0129: International Management Research Seminar**	6 C 2 WLH
Learning outcome, core skills: The participants aim to improve their communication and presentation skills. Scientific methodology knowledge, what they need later for their own thesis, will be provided in the seminar.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: International Management Research Seminar *Contents*: In this research seminar, the Master students should work independently and systematically on a research question. The participants can choose one of the current themes from the area of "International Management" or choose their own research topic from a related field.	2 WLH
Examination: Presentation (ca. 30 minutes) with written elaboration (max. 8.000 words)	6 C
Examination requirements: Demonstration of in-depth knowledge regarding the "International Management" research and development and of theoretical and practical implications obtaining from your own research project.	

Admission requirements: none	**Recommended previous knowledge:** Lecture “Organizational Behavior”, Lecture „International Human Resource Management“
Language: English	**Person responsible for module:** Prof. Israel Drori
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0130: Doing Business in Asia	6 C 2 WLH
Learning outcome, core skills: Students are brought closer to the business activities, as well as their influence, of the latest developments within the legal framework for market entry in the countries of South and East Asia. Furthermore, strategic and operational management measures for the Asian region are taught and supported with practical examples. Predominantly, the focus is going to be on China (winter semester 2015/2016). Beside the acquisition of theoretical knowledge of the management of Asian companies, the students should be prepared for a future career in companies that have business relations with Asia.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Doing Business in Asia (lecture)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Proof of knowledge of the various characteristics, methods and problems in Asian Business.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Yingying Zhang
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0133: Banking Supervision	6 C 2 WLH
Learning outcome, core skills: After a successful completion of the course students should be able to • understand and explain how banking supervision has developed over time and how it differs across jurisdictions • understand, explain and critically apply standard measures and methods of banking supervision • understand and explain the Euro area banking union • understand, explain and critically apply key concepts in banking regulation • understand, explain and critically apply key measures and methods to assess the risks of financial institutions • understand and explain micro-and macroprudential supervision and their differences	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Banking Supervision (Lecture) *Contents*: 1. Introduction (e.g. banking structure) 2. Foundations of banking supervision • Historical developments • Comparison across different jurisdictions 3. Banking Union – SSM 4. Banking Regulation • Basel III, CRDIV/CRR • ASFR model by Gordy • Further requirements on banks 5. SSM Guide on banking supervision • How is banking supervision applied? 6. Risk Analysis • Stress testing • Bank Rating 7. Microprudential versus macroprudential supervision	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: • Document an understanding how banking supervision has developed over time and how it differs across jurisdictions • Demonstrate a profound knowledge of standard measures and methods of banking supervision • Show an understanding of the Euro area banking union	

• Demonstrate the ability to explain and to some extent to apply key concepts in banking regulation • Document the knowledge to apply key measures and methods to assess the risks of financial institutions and to interpret the obtained results appropriately • Document an understanding of micro-and macroprudential supervision and their differences	

Admission requirements: none	**Recommended previous knowledge:** Modul Finanzwirtschaft, Modul Financial Risk Managmenet, Modul Rechnungslegung der Kreditinstitute
Language: English	**Person responsible for module:** Dr. Philipp Koziol
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0134: Panel Data Analysis in Marketing**	6 C 2 WLH
Learning outcome, core skills: After successful attendance the students will understand the methodological principles of panel data modeling, especially in the context of consumer behavior and marketing-mix models. Further, they will be able to conduct own panel data analyses using the statistical programming language *R*.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Panel Data Analysis in Marketing (Lecture with exercise) *Contents*: • Introduction to *R* • Refreshment in Regression Analysis • Fixed Effects Models • Random Effects Models • Dynamic Panel Models The course is open to Master and Ph.D. students.	2 WLH
Examination: Term Paper (max. 12 pages)	6 C
Examination requirements: The term paper will contain a self-conducted empirical project. Students will be provided with empirical data, but are welcome to analyze own projects. Students are advised to use the statistical programming language *R*, but can be allowed to use different statistics software in exceptional cases. Theoretical, methodological and empirical elaboration of a selected topic in panel data analysis with focus on consumer behavior and/or marketing-mix modeling.	

Admission requirements: none	**Recommended previous knowledge:** Basics in inferential statistics
Language: English	**Person responsible for module:** Dr. Ossama Elshiewy
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0135: Digital Innovations and Design Thinking**	6 C 2 WLH
Learning outcome, core skills: At the end of this active-learning based course, the student is expected to: • Comprehend the opportunities created by digital innovations • Understand and apply the process for design thinking • Design digital solutions to meet customer needs • Design and evaluate entrepreneurial action	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Digital Innovations and Design Thinking (Lecture) *Contents*: With technology disrupting firms and increasingly, entire industries, the imperative is for students to have a deep understanding of digital innovations that are likely to shape the future and have the capacity to innovate. This project-based interdisciplinary course positioned at the intersection of digital innovations, design thinking and entrepreneurship is aimed at delivering the competencies demanded by businesses, non-profits and government agencies alike – an understanding of transformational opportunities created by digital technologies and the capacity to innovate. To help students build the capacity to innovate, the course uses the design thinking framework developed at Stanford University and widely used across the world today.	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 12 pages total, divided into three parts)	6 C
Examination requirements: To pass the course, students have to write a seminar paper and give a related presentation. They have to demonstrate that they are able to systematically apply their knowledge of digital innovations and design thinking.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of Business Administration and Information Management.
Language: English	**Person responsible for module:** Prof. Balaji Rajagopalan, PhD.
Course frequency: each second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students:	

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Georg-August-Universität Göttingen **Module M.WIWI-BWL.0136: Digital Transformation**	6 C 2 WLH
Learning outcome, core skills: This course aims to develop a cross-functional and managerial understanding of digital transformation of business. Specifically, participants in this course are expected to learn about: • What concepts, frameworks, and tools can guide the general manager in executing a digital transformation initiative? • How can digital capabilities inside an incumbent firm facing potential digital disruption be built and fostered to compete? • What are the main digital drivers (e.g., cloud, social, mobile, big data) that underlie current changes in society/business? • What is the business impact of these digital drivers at the level of markets, business models, and individual work practices? • How should managers reinforce existing and foster new capabilities to be able to drive digital transformation initiatives?	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Digital Transformation (Lecture) *Contents*: Until recently, the knowledge of Information Technology (IT) and its application in the enterprise had been confined to the IT department. Not anymore. Today –in the Digital Age– successful business manager must not only know how to interpret a P&L statement and read a balance sheet, but also understand “digital” and anticipate its impact on business. The Digital Age, fueled by the drastic reduction in the cost of processing, storage, and communication, is creating a high-density digital. Technology today is both available and affordable. This creates a new phenomenon where individuals incorporate cutting-edge digital technologies in their personal lives before businesses get a chance to adopt and implement them. In a way, this leads to a new kind of digital divide -that between society and business. Customers and employees of the younger generation come with new expectations that companies are not prepared to meet. To address this challenge, today’s business leaders must be able to think digital. Thinking digital does not equal thinking IT. Digital focuses much less on process automation, transactions, and efficiency, and much more on creating new value-added experiences and interactions with customers, employees and business partners. Ultimately, it enables the firm to generate new revenue by finding unique ways to combine its physical and digital resources.	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements:	

In order to accomplish successfully this course, students are expected to document an understanding of: • Main digital drivers and their impact on society/business • Digital capabilities needed to face potential digital disruptions • Concepts and frameworks of digital transformation initiatives • Managerial capabilities needed to address digital transformation initiatives	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of Business Administration and Information Management
Language: English	**Person responsible for module:** Prof. Dr. Robert Wayne Gregory
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 30	

Additional notes and regulations: Teilnehmerbegrenzung der „Vorlesung“ aufgrund der Fallstudien.

Georg-August-Universität Göttingen Module M.WIWI-BWL.0137: Electronic Commerce Systems	6 C 2 WLH
Learning outcome, core skills: Upon completing this course the student will be able to: 1. Explain the characteristics and functions of electronic commerce including mobile commerce. 2. Describe the process of developing electronic commerce sites and mobile commerce applications. 3. Implement an electronic commerce site using open source software. 4. Explain fundamental characteristics of electronic markets. 5. Describe common business models used in B2C and B2B electronic commerce. 6. Describe security and payment in electronic commerce including mobile commerce. 7. Describe the technology used in mobile commerce. 8. List common applications in mobile commerce. 9. Speculate on the future of electronic commerce.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Electronic Commerce Systems *Contents*: This course examines the concepts, technology, and applications of electronic commerce, or e-commerce. Students are to work in teams to plan an e-commerce site for a real or hypothetical business and implement the site using PrestaShop. Students are to present their plan and implementation in a written report and in an oral presentation using PowerPoint.	2 WLH
Examination: Written examination (60 minutes) **Examination prerequisites:** Practical examination and presentation (approx. 45 minutes)	6 C
Examination requirements: To pass the course, students have to demonstrate that they are able to systematically apply their knowledge of the conceptual and technological foundations of e-commerce.	

Admission requirements: none	**Recommended previous knowledge:** Students should have a basic understanding of information systems, the Internet, and the Web.
Language: English	**Person responsible for module:** Prof. Robert C. Nickerson
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4

Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0139: Discrete Choice Modeling**	6 C 2 WLH
Learning outcome, core skills: A comprehensive course for advanced discrete choice analysis (stated vs revealed choice, cross-sectional vs repeated data, Logit, Probit, GEV, Mixed models, classic vs. Bayesian estimation, etc.) Students will be able to apply own discrete choice models using the statistical programming language R.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Discrete Choice Modeling (Lecture with exercise) *Contents*: • Multinomial Logit (MNL) and Probit Models • Generalized Extreme Value Models • Finite Mixture and Mixed MNL Models • Hierarchical Bayesian MNL Models The term paper will contain a self-conducted empirical project. Students will be provided with empirical data, but are welcome to analyze own projects. Students are advised to use the statistical programming language *R*, but can be allowed to use different statistics software in exceptional cases.	2 WLH
Examination: Term Paper (max. 12 pages)	6 C
Examination requirements: Theoretical, methodological and empirical elaboration of discrete choice modeling.	

Admission requirements: none	**Recommended previous knowledge:** Basics in probability theory and distributions, inferential statistics, maximum likelihood estimation and (logistic) regression analysis
Language: English	**Person responsible for module:** Dr. Ossama Elshiewy
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen Module M.WIWI-BWL.0140: Seminar in Empirical Research	6 C 2 WLH
Learning outcome, core skills: The aim of this course is to familiarize students with the basic concepts and understanding about empirical research in business and economics. In this seminar students learn how to choose a paper, and replicate its results using a different dataset.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: An Introduction to Empirical Research in Business and Economics (Seminar) *Contents*: 1. Where to start 2. The Basics 3. Choosing a Paper 4. Choosing the Data 5. Replication	2 WLH
Examination: Term Paper (max. 15 pages) **Examination requirements:** In order to accomplish successfully this course, students are expected to: • Understand the assigned paper • Find a dataset that matches their model • Replicate the paper • Interpret the results	6 C

Admission requirements: none	**Recommended previous knowledge:** • Econometrics • Stata • General Knowledge about the economic theory
Language: English	**Person responsible for module:** Prof. Dr. Andreas Oestreicher
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module M.WIWI-BWL.0142: Publishing in Management Journals**	6 C 2 WLH
Learning outcome, core skills: 1. To explore current debates in Human Resource Management 2. To become familiar with examples of good empirical research 3. To produce an academic (seminar) paper	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Publishing in Management Journals (Seminar) *Contents*: This is a seminar for (advanced) master students with the aspiration to pursue a PhD after finishing their Master studies. The purpose of this course is to give students practice in crafting manuscripts that are publishable in scholarly journals. Discussing and learning from peer-reviewed scholarly papers and other students' work-in-progress papers will be the primary format of this course. Preparing assigned reading material and working on your own paper are thus of the utmost importance.	2 WLH
Examination: Presentation (ca. 20 minutes) with written elaboration (max. 8000 words) **Examination prerequisites:** Regular active attendance.	6 C
Examination requirements: To pass the course, students have to demonstrate that they are able to systematically apply their knowledge of discussing, understanding and writing academic articles published / publishable in scholarly journals.	

Admission requirements: none	**Recommended previous knowledge:** first academic writing skills
Language: English	**Person responsible for module:** Prof. Dr. Fabian Froese
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0001: Generalized Linear Models**	6 C 4 WLH
Learning outcome, core skills: The students • gain an overview on extended regression modelling techniques that allow to analyse data with non-normal responses. • learn about approaches for modeling nonlinear effects in scatterplot smoothing. • get an introduction to additive models for complex regression analyses. • learn how to implement these approaches using statistical software packages.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Generalized Linear Models (Lecture) *Contents*: Generalized linear models (binary and Poisson regression, exponential families, maximum likelihood estimation, iteratively weighted least squares regression, tests of hypotheses, confidence intervals, model selection and model checking, categorical regression models), nonparametric smoothing techniques (penalized spline smoothing, local smoothing approaches, general properties of scatterplot smoothers, choosing the smoothing parameter, bivariate and spatial smoothing, generalized additive models)	2 WLH
2. Generalized Linear Models (Tutorial)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion) **Examination requirements:** In the exam, the students demonstrate their ability to choose, fit and interpret extended regression modeling techniques. They show a general understanding of the derived estimates and their interpretation in various contexts. The students are able to implement complex regression models using statistical software and to interpret the corresponding results. The exam covers contents of both the lecture and the exercise class.	6 C

Admission requirements: none	**Recommended previous knowledge:** Lineare Modelle
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: not limited	

Additional notes and regulations:
The actual examination will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0002: Advanced Statistical Inference (Likelihood & Bayes)**	6 C 4 WLH

Learning outcome, core skills: The students • learn about the foundations and general properties of likelihood-based inference in statistics. • get familiar with the Bayesian approach to statistical learning and its properties. • learn how to implement both approaches in statistical software using appropriate numerical procedures.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Advanced Statistical Inference (Likelihood & Bayes) (Lecture)** *Contents*: The likelihood function and likelihood principles, maximum likelihood estimates and their properties, likelihood-based tests and confidence intervals (derived from Wald, score, and likelihood ratio statistics), expectation maximization algorithm, Bootstrap procedures (estimates for the standard deviation, the bias and confidence intervals), Bayes theorem, Bayes estimates, Bayesian credible intervals, prior choices, computational approaches for Bayesian inference.	 2 WLH
2. Advanced Statistical Inference (Likelihood & Bayes) (Tutorial)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion) **Examination requirements:** The students demonstrate their general understanding of likelihood-based and Bayesian inference for different types of applications and research questions. They know about the advantages and disadvantages as well as general properties of both approaches, can critically assess the appropriateness for specific problems, and can implement them in statistical software. The exam covers contents of both the lecture and the exercise class.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: every year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: not limited	

Additional notes and regulations:
The actual examination will be published at the beginning of the semester.

Georg-August-Universität Göttingen Module M.WIWI-QMW.0004: Econometrics I	6 C 4 WLH
Learning outcome, core skills: This lecture provides a detailed introduction and discussion to the theory of several topics of econometrics. In a practical course the students will apply the methods discussed to real economic data and problems using the statistical software packages Eviews and R.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Econometrics I (Lecture)** *Contents*: Multiple linear regression model: Estimation, Inference and Asymptotics. Maximum likelihood modeling. Generalized least squares. Stochastic regressors. Intrumental variable estimators. Generalized method of moments, likelihood based inference. Dynamic models, weak exogeneity, cointegration, stochastic integration.	 2 WLH
2. Econometrics I (Tutorial)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Linear regression models, generalized linear regression models. OLS, GLS, EGLS estimation. Multiplikative heteroskedasticity, autocorrelation. LM specification testing, Durbin Watson test. Convergence in probability, convergence in distribution. Asymptotics (consistency, asymptotic normality) of OLS estimators. IV estimation, GMM estimation.	6 C
Examination requirements: Linear regression models, generalized linear regression models. OLS, GLS, EGLS estimation. Multiplikative heteroskedasticity, autocorrelation. LM specification testing, Durbin Watson test. Convergence in probability, convergence in distribution. Asymptotics (consistency, asymptotic normality) of OLS estimators. IV estimation, GMM estimation.	

Admission requirements: None	**Recommended previous knowledge:** Notwendige: Mathematik (lineare Algebra), Statistik. Erwünscht: Einführung in die Ökonometrie (oder vergleichbare Vorlesung)
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0005: Econometrics II**	6 C 4 WLH
Learning outcome, core skills: This advanced course extends techniques and theory introduced in the lecture Econometrics I. The use of econometrics in estimating models derived from theory is illustrated. The application of these methods on real data using the statistical software package Eviews as well as R is practiced in exercises.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Econometrics II (Lecture)** *Contents*: Models with binary explanatory variables, seemingly unrelated regressions. Multi-equation dynamic models, simultaneous equation models, vector autoregressions, (vector) error correction models, models with binary dependent variables.	 2 WLH
2. Econometrics II (Tutorial)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Dynamic models. Stochastic trends. Unit roots. Spurious regressions. Stochastic integration. Cointegration modeling (ECM, testing for integration and cointegration, weak exogeneity, causality analysis). 2 and 3 SLS estimation. Higher dimensional modelling (joint endogeneity). Logit/Probit estimation.	6 C

Admission requirements: none	**Recommended previous knowledge:** Modul "Ökonometrie I"
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0006: Seminar in Applied Statistics and Econometrics**	6 C 2 WLH

Learning outcome, core skills: The students • gain a better understanding of statistical and econometric models by studying current literature on both methodology and case studies. • learn how to present statistical methods and results to a mixed audience. • gain the ability to read and understand literature related to current advances in statistics and econometrics. • get an introduction to good scientific practice. • improve their presentation and English skills.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Seminar in Applied Statistics and Econometrics (Seminar) *Contents*: The seminar deals with different current topics in statistics and econometrics and may focus on case studies and/or methodological innovations.	2 WLH

Examination: Presentation (ca. 60 minutes) with written elaboration (max. 15 pages)	6 C

Examination requirements: The credits for the seminar are earned through a presentation in combination with a written homework on the same subject. The students demonstrate their ability to present statistical and econometric models and results and to document their findings in a corresponding report.	

Admission requirements: none	**Recommended previous knowledge:** Necessary: Mathematics, Statistics in addition: Introduction to econometrics or Econometrics I
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0007: Selected Topics in Statistics and Econometrics**	6 C 4 WLH
Learning outcome, core skills: The students • learn about a specific current strand of statistical and/or econometric research. • learn how to implement these approaches in statistical software packages and how to interpret the corresponding results.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Selected topics in Statistics and Econometrics (Lecture)** *Contents*: Current topics in statistics and/or econometrics.	2 WLH
2. Selected topics in Statistics and Econometrics (Tutorial)	2 WLH
Examination: Written exam (90 minutes)	6 C
Examination requirements: The students demonstrate their general understanding of the topics dealt with in the lecture and the exercise class. They know how to interpret results from the corresponding models and how to implement these models in statistical software. The exam covers contents of both the lecture and the exercise class.	

Admission requirements: none	**Recommended previous knowledge:** Statistics
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: every 4. semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0009: Introduction to Time Series Analysis**	6 C 4 WLH
Learning outcome, core skills: The students • learn concepts and techniques related to the analysis of time series and forecasting. • gain a solid understanding of the stochastic mechanisms underlying time series data. • learn how to analyse time series using statistical software packages and how to interpret the results obtained.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Introduction to Time Series Analysis (Lecture)** *Contents*: Classical time series decomposition analysis (moving averages, transformations of time series, parametric trend estimates, seasonal and cyclic components), exponential smoothing, stochastic models for time series (multivariate normal distribution, autocovariance and autocorrelation function), stationarity,spectral analysis, general linear time series models and their properties, ARMA models, ARIMA models, ARCH and GARCH models.	 2 WLH
2. Introduction to Time Series Analysis (Tutorial)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** The students show their ability to analyse time series using specific statistical techniques, can derive and interpret properties of stochastic models for time series, and can decide on appropriate models for given time series data. The students are able to implement time series analyses using statistical software and to interpret the corresponding results. The exam covers contents of both the lecture and the exercise class.	6 C

Admission requirements: none	**Recommended previous knowledge:** Statistics
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: every year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0010: Multivariate Statistics	6 C 4 WLH
Learning outcome, core skills: The students: • learn the basic concepts of multivariate data analysis • know how to apply the most common methods of multivariate statistics in practice • learn how to implement multivariate statistical approaches using the software package R • know how to interpret the results of multivariate data analyse	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Multivariate Statistics** (Lecture) *Contents*: Multivariate distributions and their properties, multivariate normal distribution, principal component analysis, factor analysis, discriminant analysis, cluster analysis	 2 WLH
2. Multivariate Statistics (Exercise)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion)	6 C
Examination requirements: In the exam, the students demonstrate that they are able to apply the basic concepts of multivariate statistics. They can decide for a suitable procedure given an applied problem, implement the approach in statistical software and interpret the results. The exam consists of material from both the lecture and the exercise class.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0011: Statistical Programming with R	6 C 4 WLH
Learning outcome, core skills: The students learn how to independently implement and optimize advanced statistical methodology with the statistical software package R	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Statistical Programming with R (Lecture with tutorial) *Contents*: The students work on advanced statistical programming projects using methods and techniques they got to know in the "Introduction to R". This involves implementation of advanced statistical methodology, utilising tools for debugging and profiling code and documenting the code. The progress of the projects is documented in a presentation and a written report.	4 WLH
Examination: Term paper (max. 15 pages) **Examination prerequisites:** Practical examination and presentation (approx. 15 minutes)	6 C
Examination requirements: The students work on a programming project and document their work in a written report and a presentation.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0012: Multivariate Time Series Analysis	6 C 4 WLH
Learning outcome, core skills: The students • learn concepts and techniques related to the analysis of multivariate time series and the forecasting thereof. • learn to characterize the dynamic interrelationship between the variables of dynamic systems • learn to relate economic models with restrictions implied by its empirical counterpart • learn how to analyse multivariate time series using by means of statistical software packages and to interpret the results obtained.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Multivariate Time Series Analysis (Lecture)** *Contents*: Vector Autoregressive and Vector Moving Average representations Model selection and estimation, Unit roots in vector processes, Vector autoregressive vs. vector error correction modeling, structural vectorautoregressions, Impulse response analysis, forecasting, forecast error variance decomposition	2 WLH
2. Multivariate Time Series Analysis (Tutorial)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** The students show their ability to analyse systems of time series using specific statistical techniques, can derive and interpret properties of stochastic models for time series, and can decide on appropriate models for given data. The students are able to implement time series analyses using statistical software and to interpret the corresponding results. The exam covers contents of both the lecture and the exercises.	6 C

Admission requirements: none	**Recommended previous knowledge:** Modul "Statistik", Modul "Econometrics I", Modul "Introduction to Time Series Analysis"
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0014: Mathematical Foundations of Applied Statistics**	6 C 4 WLH
Learning outcome, core skills: The students: • get to know the basic mathematical knowledge required for a thorough understanding of statistical methods • learn how to apply this mathematical knowledge on practical statistical problems.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Mathematical Foundations of Applied Statistics *Contents*: Integration and differentiation, matrix calculus (elementary operations, rank, inverse, determinant, trace, eigen values and vectors, quadratic forms, differentiation of matrix functions), probability calculus (univariate distributions and their properties, random vectors and their properties, conditional distributions, multivariate normal distribution)	
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion)	6 C
Examination requirements: The students demonstrate their ability to use the most common mathematical tools in applied statistics to solve mathematical problems. They know different such approaches and can decide upon an appropriate one for a given problem.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Heike Bickeböller Prof. Dr. Tim Friede, Prof. Dr. Thomas Kneib
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1

Additional notes and regulations: The actual examination will be published at the beginning of the semester.

Georg-August-Universität Göttingen Module M.WIWI-QMW.0016: Spatial Statistics	6 C 4 WLH

Learning outcome, core skills: The students • learn about the principle possibilities to include spatial information in statistical models. • acquire experience in the practical analysis of spatial data • learn how to interpret the results of spatial analyses	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses: **1. Spatial Statistics (Lecture)** *Contents*: Statistical analysis of spatially oriented data, spatial models for point-referenced data (geostatistics, kriging), spatial models for regional data (Markov randomfields), spatial point processes, spatial stochastic processes, statistical inference in spatial statistics.	2 WLH
2. Spatial Statistics (Tutorial)	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion) **Examination requirements:** The students show in the exam that they have learned to perform the basic steps and calculartions involved in analyses of spatial data. They can choose the most appropriate model for a given problem and can implement this model in statistical software. In addition. The resulting estimates can be interpreted and the results can be critically evaluated. The exam covers contents of both the lecture and the exercise class.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: every year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Additional notes and regulations: The actual examination will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0019: Statistical Methods for Impact Evaluation**	6 C 4 WLH
Learning outcome, core skills: There are many questions in social science that depend on causal effects of social policies or programs. This course attempts to present a review of the practical issues for empirical researchers on the econometric and statistical analysis of the effects of such programs or treatments.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Statistical Methods for Impact Evaluation *Contents*: • New Methods in Program Evaluation: • Difference-in-difference • Matching techniques • Instrumental variables • Regression discontinuity design • Combined methods The computer software package STATA will be used for practical work. Previous knowledge of intermediate econometrics is required.	4 WLH
Examination: Presentation (approx. 20 min.) with written elaboration (max. 15 pages text) **Examination requirements:** New Methods in Program Evaluation: • Difference-in-difference • Matching techniques • Instrumental variables • Regression discontinuity design • Combined methods	6 C

Admission requirements: none	**Recommended previous knowledge:** Modul "Econometrics I"
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0020: Practical Statistical Training	6 C 2 WLH
Learning outcome, core skills: The students: • learn how to implement statistical procedures for a given applied problem in a collaboration • learn how to present results from a statistical analysis • can identify a suitable statistical approach for a given problem, apply it and interpret the results.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Statistical Consulting *Contents*: In collaboration with a collaboration partner providing the applied research question, the students develop statistical solutions in groups of up to four students.	2 WLH
Examination: Term Paper (max. 20 pages) **Examination prerequisites:** Two presentations	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib Prof. Dr. Heike Bickeböller, Prof. Dr. Tim Friede
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0021: Introduction to R**	3 C 2 WLH
Learning outcome, core skills: The students: • get to know the basic functionality of the statistical software package R • can implement advanced statistical approaches in R while using approproate tools for optimising the code	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Introduction to R (Lecture with tutorial) *Contents*: Data types and class structures, vectors and matrives, reading and writing data, statistical graphics, creating R packages, including other programming languages, debugging and profiling code, S3 and S4 classes, Trellis graphics and other advanced graphics features	2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes) **Examination prerequisites:** Presentation (approx. 40 minutes) or Exercises (50% successful completion) **Examination requirements:** The students work on a programming project and document their work in a written report.	3 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 30	

Additional notes and regulations:
The actual examination will be published at the beginning of the semester.

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0024: Financial Liberalization, Financial Development and Economic Growth**	6 C 2 WLH
Learning outcome, core skills: Students acquire knowledge on the state of the art research on the relationship between financial liberalization, financial development and economic growth. They also learn how to formulate their research question and how to develop their arguments based on a critical review of the related literature. Furthermore, they improve their academic writing and presentation skills.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Financial Liberalization, Financial Development and Economic Growth (Seminar) *Contents*: The seminar covers topics on the role of financial liberalization and financial development in economic growth. It also covers topics on the relationship between financial liberalization and financial development.	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: In the paper, students should demonstrate their ability to critically review scientific papers, synthesize the results and develop a clear argument supported by the evidence in the literature. They should also demonstrate their ability to write a scientific paper. In the presentation, they should demonstrate their ability to present key insights from complex theoretical and empirical papers, and to present and defend an argument on the research question developed from the literature.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Yabibal Walle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0025: Development Microeconometrics	6 C 4 WLH
Learning outcome, core skills: The aim of this course is to familiarize students with contemporary microeconometric tools widely applied in development economics. This course will briefly explain selected micro-level empirical questions in development economics and discuss in detail the econometric methods that could be applied to examine those issues. However, no effort will be devoted to prove econometric theories. There will also be computer lab sessions where we will be mainly using Stata. Successful participants of this course are expected to be familiar with important microeconometric tools in development economics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Development Microeconometrics** (Lecture) *Contents*: 1. Pure cross sectional regressions: basic concepts and tests 2. Instrumental variables estimation and two stage least squares 3. Panel data approaches: fixed effects estimator and random effects estimator, dynamic panel data estimators 4. Models with limited dependent variables: Logit, Probit, Multinomial logit, Count data models, Ordered logit, Tobit model, Heckman’s sample selection model, estimating treatment effects	 2 WLH
2. Computer excercises with STATA (Exercise)	2 WLH
Examination: Written examination (90 minutes) or oral examination (20 minutes)	6 C
Examination requirements: In the exam, participants are expected to show their familiarity with and understanding of main microeconometric tools used in development economic.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to econometrics
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: each second wintersemester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0026: Development Macroeconometrics	6 C 4 WLH

Learning outcome, core skills: The aim of this course is to familiarize students with contemporary econometric tools widely applied in the research on growth and inequality. This course will briefly explain selected empirical questions in growth and inequality and discuss in detail the econometric methods used to tackle those issues. However, no effort will be devoted to prove either economic or econometric theories. On each topic, selected empirical applications will be presented both in the lecture and in computer lab sessions where we will be mainly using STATA. Successful participants of this course are expected to be familiar with important macroeconometric tools in development economics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Development Macroeconometrics (Lecture) *Contents*: 1. Introduction to growth theory 2. Econometrics of growth (a) Pure cross sectional regressions, (b) Panel data approaches: pooled OLS, fixed effects estimator and random effects estimator, GMM estimators, mean-group and panel mean group estimators (c) Time series approaches: (unit root tests, cointegration tests, estimation of the long run parameters, vector error correction model, Granger causality (d) Panel generalizations of time series approaches: panel unit root and cointegration tests 3. Econometrics of inequality (a) Macro-level approaches: model specifications of selected papers	2 WLH
2. Computer excercises with STATA (Exercise)	2 WLH

Examination: Written examination (90 minutes) or oral examination (20 minutes)	6 C

Examination requirements: In the exam, participants are expected to show their familiarity with and understanding of main macroeconometric tools used in the research on growth and inequality.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to econometrics
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: each second wintersemester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4

Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0027: Advanced Meta-Research in Economics	6 C 4 WLH
Learning outcome, core skills: The students learn to critically reflect the reliability of empirical research in economics. They learn to make themselves familiar with the methodology used in a recent study and to replicate this study. They also learn to identify the key assumptions of the estimation procedure by performing a sensitivity analysis.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Advanced Meta-Research in Economics** (Lecture) *Contents*: This module discusses the incentive system of academic publishing and its consequences for the reliability of empirical research in economics. We show how *p*-hacking and publication bias distort published empirical findings and we illustrate the state of empirical economic research by discussing recent articles from the field of meta-research in economics. We introduce meta-analytic concepts such as the *p*-curve and meta-regression models that attempt to identify genuine effects in the presence of bias. Finally, we discuss the important role of replications in improving the reliability of empirical research in economics.	 2 WLH
2. Advanced Meta-Research in Economics (Exercise)	2 WLH
Examination: Practical examination with written elaboration (max. 15 pages)	
Examination requirements: Each student chooses a recent study and replicates its findings by using the statistical software R. Each student also conducts a sensitivity analysis of the results by using, for example, alternative specifications or data (max. 15 pages). The students show that they can replicate the findings of a recent study and that they can perform a sensitivity analysis.	

Admission requirements: none	**Recommended previous knowledge:** Good knowledge of applied econometrics
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz Dr. Stephan Bruns
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0028: Topics in Descriptive Statistics	12 C 2 WLH
Learning outcome, core skills: The students: • know the state of the art as well as future challenges regarding a current research theme in descriptive statistics • have profound knowledge within the research field they worked upon • know and understand methods and approaches in order to elaborate on • statistical research in a scientific manner • can elaborate research questions systematically by means of scientific methods	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: Topics in empirical Analysis (Seminar)	2 WLH
Examination: Presentation ca. 30 minutes) with written elaboration (max. 8000 words) **Examination prerequisites:** Regular attendance; participation on possibly excursions	
Examination requirements: • Scientific and solution-oriented elaboration of current topics in descriptive statistics • Writing a seminar paper • Oral presentation of the seminar paper’s findings • Collaboration with other students in teams	

Admission requirements: none	**Recommended previous knowledge:** Good knowledge of "R"
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-QMW.0029: Seminar in Operations Research	6 C 2 WLH
Learning outcome, core skills: The aim of this course is to familiarize students with the basic concepts and understanding about empirical research in business and economics. In this seminar students learn how to choose a paper, and replicate its results using a different dataset.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: An Introduction to Empirical Research in Business and Economics (Seminar) *Contents*: 1. Where to start 2. The Basics 3. Choosing a Paper 4. Choosing the Data 5. Replication	2 WLH
Examination: Presentation (ca. 30 minutes)	
Examination requirements: In order to accomplish successfully this course, students are expected to: • Understand the assigned paper • Find a dataset that matches their model • Replicate the paper • Interpret the results	

Admission requirements: none	**Recommended previous knowledge:** Good knowledge of "R"
Language: English	**Person responsible for module:** Prof. Dr. Thomas Kneib
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0008: Development Economics I: Macro Issues in Economic Development**	6 C 4 WLH
Learning outcome, core skills: Expose students to macroeconomic issues in economic development, including how economic growth, trade, inequality, aid, capital flows, and population issues affect economic development. They understand historical roots of underdevelopment and acquire knowledge of current economic models and empirical approaches in these topic areas.	**Workload:** Attendance time: 42 h Self-study time: 138 h
Courses: **1. Development Economics I (Lecture)**	2 WLH
2. Development Economics I (Tutorial)	2 WLH
Examination: Written Exam	6 C
Examination requirements: The students demonstrate a good understanding of key theories and models of economic development. They are able to critically present these theories and models, are able to interpret empirical results that relate to these models, and are able to crucially draw relevant policy conclusions coming out of these models and empirical assessments.	

Admission requirements: None	**Recommended previous knowledge:** Knowledge of macroeconomics and econometrics at BA level is highly desirable.
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0009: Development Economics II: Micro Issues in Development Economics**	6 C 4 WLH
Learning outcome, core skills: Expose students to microeconomic issues in economic development, including the role of poverty, measurement, and linkages between fertility, undernutrition, and poorly functioning labor, capital, and land markets and poverty in rural areas. It should also equip students to develop and assess policy options for poverty reduction.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Development Economics II (Lecture)	2 WLH
2. Development Economics II (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: The students demonstrate a good understanding of key micro theories and models of poverty in developing countries. They are able to critically present these theories and models, are able to interpret empirical results that relate to these models, and are able to crucially draw relevant policy conclusions coming out of these models and empirical assessments.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of microeconomics and econometrics at BA level is highly desirable. Development Economics I is not a prerequisite.
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0010: Development Economics III: Regional Perspectives in Development Economics**	6 C 3 WLH
Learning outcome, core skills: Allow students to apply theoretical and empirical concepts in development economics to understand differences in regional economic development. Familiarize students with differences of the development experience East Asia, South Asia, Latin America, and Sub Saharan Africa, including the most important determinants of these differences.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Development Economics III (Lecture)	2 WLH
2. Development Economics III (Tutorial)	1 WLH
Examination: Written examination (90 minutes)	3 C
Examination: Term Paper (max. 10 pages)	3 C
Examination requirements: In the term paper, students demonstrate their ability to develop a coherent argument on a particular regional or comparative issue in economic development. In the exam, students demonstrate their ability to apply their knowledge of development economics theory and empirical assessments to interpret and explain key issues affecting regional economic development.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of macroeconomics and econometrics at BA level is highly desirable. Knowledge of development economics (at least at BA level, but preferably at MA level) also recommended (e.g. taking Development Economics I or II concurrently)
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0018: Economic Development of Africa**	6 C 3 WLH

Learning outcome, core skills: Allow students to apply theoretical and empirical concepts in development economics to understand historical and current-day economic development issues in Africa, including policy initiatives to tackle economic development in the continent.	**Workload:** Attendance time: 42 h Self-study time: 138 h

Courses:	
1. Economic Development of Africa (Lecture)	2 WLH
2. Economic Development of Africa (Tutorial)	1 WLH

Examination: Written examination (90 minutes)	3 C

Examination: Term Paper (max. 10 pages)	3 C

Examination requirements: In the term paper, students demonstrate their ability to develop a coherent argument on a particular issue in African economic development. In the exam, students demonstrate their ability to apply their knowledge of development economics theory and empirical assessments to interpret and explain key issues affecting African economic development.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of macroeconomics and econometrics at BA level is highly desirable. Knowledge of development economics (at least at BA level, but preferably at MA level) also recommended (e.g. taking Development Economics I or II concurrently)
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every 4. semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0019: Advanced Development Economics**	6 C 4 WLH
Learning outcome, core skills: Allow students to acquaint themselves with cutting edge research in development economics. The topics covered will vary from time to time, always focusing on new and emerging issues in development economics research.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Advanced Development Economics (Lecture)	2 WLH
2. Advanced Development Economics (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: In the exam, students demonstrate their ability to interpret cutting edge research in development economics, including critically evaluating models, theories, and econometric techniques.	

Admission requirements: none	**Recommended previous knowledge:** Development Economics I+II or equivalent. Knowledge of MA level econometrics plus good knowledge of MA level development economics highly desirable.
Language: English	**Person responsible for module:** Prof. Stephan Klasen Prof. Ibanez Diaz, N.N.
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0021: Gender and Development**	6 C 3 WLH

Learning outcome, core skills: Allow students to understand key theoretical and empirical approaches to understanding gender inequality in developing countries, including gender gaps in education, health and mortality, employment, time-use, and governance. Familiarize students with different approaches to conceptualize and measure gender gaps and enable them to analyze policies to tackle gender inequality.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Courses:	
1. Gender and Development (Lecture)	2 WLH
2. Gender and Development (Tutorial)	1 WLH

Examination: Written examination (90 minutes)	3 C

Examination: Term Paper (max. 10 pages)	3 C

Examination requirements: In the term paper, students demonstrate their ability to develop a coherent argument on a particular issue of gender inequality in developing countries. In the exam, students demonstrate their ability to understand theory and empirical assessments of gender inequality, including measurement, and policy issues.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of development economics (at least at BA level, but preferably at MA level) also recommended (e.g. taking Development Economics I or II concurrently)
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every 4. semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0022: Analysis of Micro Data**	6 C 4 WLH
Learning outcome, core skills: Allow students to acquaint themselves with cutting edge methods in the analysis of micro data, with particular emphasis on analyzing microeconometric issues in developing countries.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Analysis of Micro Data (Lecture)	2 WLH
2. Analysis of Micro Data (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	3 C
Examination: Term Paper (max. 10 pages)	3 C
Examination requirements: In the exam, students demonstrate their ability to interpret cutting edge research in the analysis of household surveys, including the ability to formulate an econometric research strategy to analyze a particular research question, and evaluating econometric studies from both a methodological and substantive perspective.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of MA level econometrics highly desirable.
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every 4. semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0023: Seminar to the Situation of Latin America in the 21st Century: Trade Related and Macroeconomic Issues**	6 C 2 WLH

Learning outcome, core skills: • Students learn how to formulate research questions • Students have a close look at theoretical studies/arguments in related field • Students familiarize with the empirical literature in related field • Students utilize the empirical methodology to evaluate the results obtained in the empirical literature • Students give reasons why theory and empirics are compatible or not • Students draw economic policy conclusions from empirical results	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Seminar to the situation of Latin America in the 21st century: Trade related and macroeconomic issues (Seminar) *Contents*: In this course international trade issues ,such as • international competitiveness (exchange rate policy and transport costs); • determinants of current account deficits • choice of exchange rate system • economic integration (North-South; South-South); • analysis of trade agreements • the role of trade liberalization (unilateral, bilateral, at the WTO level) will be dealt with.	2 WLH

Examination: Presentation (approx. 20 min) with written elaboration (max. 15 pages text) **Examination prerequisites:** Regular active attendance.	6 C

Examination requirements: Knowledge of macroeconomics and international trade themes to Latin America.	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of open economy macroeconomics; of international trade; of some basic econometrics
Language: English	**Person responsible for module:** Dr. rer. pol. Felicitas Nowak-Lehmann Danzinger
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0024: Seminar to the situation of Latin America in the 21st century: The necessity of reforms**	6 C 2 WLH
Learning outcome, core skills: • Students learn how to formulate research questions • Students have a close look at theoretical studies/arguments in related field • Students familiarize with the empirical literature in related field • Students utilize the empirical methodology to evaluate the results obtained in the empirical literature • Students give reasons why theory and empirics are compatible or not • Students draw economic policy conclusions from empirical results	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar to the situation of Latin America in the 21st century: The necessity of reforms (Seminar) *Contents*: In this course structural problems and issues ,such as • over-indebtedness • sustainability of current account deficits • structural adjustment programs • effectiveness of development aid • global developments and its impact on Latin American economies will be dealt with.	2 WLH
Examination: Presentation (approx. 20 min) with written elaboration (max. 15 pages text) **Examination prerequisites:** Regular active attendance.	6 C
Examination requirements: Knowledge of actual socio-economic themes to Latin America	

Admission requirements: none	**Recommended previous knowledge:** Knowledge of open economy macroeconomics; of basic international trade; of some basic econometrics
Language: English	**Person responsible for module:** Dr. rer. pol. Felicitas Nowak-Lehmann Danzinger
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 24	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0025: Seminar Development Economics IV**	6 C 2 WLH
Learning outcome, core skills: Students learn how to work through cutting edge research on a particular issue in development economics, develop a coherent argument addressing their research question, improve their academic writing, and learn how to present such work in front of an academic audience.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar Development Economics IV (Seminar)	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: In the paper, students demonstrate their ability to critically review academic studies on a particular topic, able to synthesize the results and develop a clear argument backed by the evidence in the literature. They also demonstrate their ability to research the scientific literature, and write a scientific paper. In the presentation, they demonstrate their ability to present key insights from complex theoretical and empirical papers, and to present and defend an argument on the research question developed from the literature.	

Admission requirements: none	**Recommended previous knowledge:** Keine
Language: English	**Person responsible for module:** Prof. Stephan Klasen
Course frequency: every 4. semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0035: Economic Effects of Regional Integration**	6 C 2 WLH
Learning outcome, core skills: Students should learn how to formulate research questions. They are expected to provide a critical assessment of the theoretical studies/arguments in the related field and to review the related empirical literature. Students should also learn how to apply the empirical methodology to evaluate the results obtained in the empirical literature, provide some reasons why theory is confirmed or not with empirics and draw economic policy conclusions from empirical results.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Economic Effects of Regional Integration (Seminar) *Contents*: • Regionalism versus Multilateralism in the World Economy • European Integration: EU, MU, East Enlargement • Latin American Integration • Asian Regionalism • African Integration	
Examination: Presentation (ca. 20 min.) with written elaboration (max. 15 pages text) **Examination prerequisites:** Regular active attendance.	6 C

Admission requirements: none	**Recommended previous knowledge:** International Economics Introductory econometrics
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 18	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0040: Empirical Trade Issues	6 C 4 WLH
Learning outcome, core skills: This course is intended to cast light on present-day controversies in international trade through study of contemporary trade theories and assessment of the latest empirical analysis of five important topics of international trade research. The main aim is to improve students' ability to evaluate and to undertake empirical research in international trade. All readers are expected to have completed graduate courses in microeconomics and econometrics.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Empirical Trade Issues (Lecture)** *Contents*: The course is organized along five empirical questions: 1. What do countries trade? 2. Why has trade increased so much? 3. Why do we still trade so little? 4. Did globalization contribute to the rise in inequality? 5. Does trade increase productivity? We will learn the necessary modeling tools and empirical instruments that help answer these questions. The course will be structured around a series of lectures (2SWS), supplemented by class discussion, and tutorials (2SWS) in which students will solve empirical exercises using STATA (based on Feenstra, 2004 and on De Benedictic and Salvatici, 2011) that replicate the results on some research papers.	2 WLH
2. Empirical Trade Issues (Tutorial)	2 WLH
Examination: Term Paper (max. 10 pages, based on the tutorial)	
Examination: Written examination (120 minutes)	
Examination requirements: Trade theory, empiric results of the main questions to international trade and the actual scientific debate	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Microeconomics, Econometrics I, International Economics
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	2 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0041: Panel Data Econometrics**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Static and dynamic panel data models for continuous and discrete dependent variables. Empirical evaluation of economic models is an important feature of the study and application of economics. The course is concerned with the *application* of econometric methods, with little emphasis on the mathematical aspects of the subject (which may be studied in other modules). The computer software package STATA will be used for practical work. Previous knowledge of intermediate econometrics is required. This course aims to study panel data econometric techniques in an intuitive and practical way and to provide the skills and understanding to read and evaluate empirical literature and to carry out empirical research.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Panel Data Econometrics (Lecture)	2 WLH
2. Panel Data Econometrics (Tutorial)	2 WLH

Examination: Term Paper (max. 10 pages, based on the tutorial)	

Examination: Written examination (120 minutes)	

Examination requirements:	
Static panel data models; Fixed effects; random effects; Between estimation; Dynamic panel data models; Arellano-Bond estimator; Pooled mean group estimation; discrete choice Stata	

Admission requirements: none	**Recommended previous knowledge:** Econometrics I
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0042: European Economy	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
The key learning objectives are: • Students should understand the extent of economic integration in the EU and the basics of EU law and its basic institutional structure and economic facts about European nations. Students should also learn the broad outline of the EU budget on the receipts and expenditure side and the basic content and the structure and problems with the Constitutional Treaty and the subsequent Treaty of reform. • Acquire knowledge of the standard open-economic supply and demand diagrams and how they can be used to analyze the positive and normative impact of tariffs. Students should also learn about the various types of trade barriers that can constrain trade. • Learn to apply open-economy supply and demand analysis to a three country setting with the aim of illustrating the main positive and normative effects of preferential liberalization on aspects of European integration. Students should also learn about the differences between customs unions and free trade areas and about WTO disciplines and about the nature of empirical studies into the effects of EU market integration. • Learn the economics behind the notion that integrating European markets can improve economic efficiency by giving European firms better access to a wider market. As part of this, students learn about market interactions in the presence of imperfect competition and increasing returns. • Learn the economic logic that explains how integrating European markets can increase income growth rates in the medium term and in the long term and the specific features of Europe’s labour markets and key labour economics principles. Students should also learn about the sources of unemployment and the microeconomics of labour market integration and the conflict between efficiency and social imperatives, as well as understand the impact of economic integration and migration on labour markets. • Learn about the CAP, which is by far the most important policy in terms of the budget and it is one of the most important in terms of EU politics. Students should also learn about recent reforms to the CAP based on de-coupling. • Learn about the very uneven distribution of economic activity in Europe and about the economics that helps account for this result as well as using the suitable framework for understanding how deeper integration affects the distribution. Also learn about EU regional policy, essentially designed to prevent geographic concentration or to ameliorate its effects on people living in rural areas. • Acquire Knowledge of the basic facts of the EU’s trade pattern both in terms of partners and commodity composition and become familiar with the basic institutions of EU trade policy making and acquire a basic understanding of the EU’s external trade policy	Attendance time: 28 h Self-study time: 152 h

Courses:	

1. European Economy (Lecture) *Contents*: The aim of this course is to cover some economic aspects of the European integration process, focusing on the European Union internally and on its relations with partners, including prospective members. Customs union theory, microeconomic policies and regional economics will be covered. Students will be expected to understand the basic economics of integration, as well as knowing how to track down up-to-date policy materials on the web. A key starting point is the official site:http://www.europa.eu.int. The course is organized as a series of lectures complemented with tutorials and student presentations of selected topics. Students are expected to prepare a short essay (10 pages) that has to be presented and discussed towards the end of the course. A list of topics will be available online (studip).	2 WLH
2. European Economy (Tutorial)	2 WLH

Examination: Written examination (90 minutes)	

Examination: Presentation (approx. 15 minutes) with witten elaboration (max. 10 pages text)	

Examination requirements: Integration theory; Customs union theory; European economic integration; Economic relations to potential members; Actual effects of integration - empiric results of the effects	

Admission requirements: none	**Recommended previous knowledge:** Microeconomics, Macroeconomics
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0046: Topics in European and Global Trade	6 C 2 WLH
Learning outcome, core skills: Students should learn how to formulate research questions. They are expected to provide a critical assessment of the theoretical studies/arguments in the related field and to review the related empirical literature. Students should also learn how to apply the empirical methodology to evaluate the results obtained in the empirical literature, provide some reasons why theory is confirmed or not with empirics and draw economic policy conclusions from empirical results.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar Topics in European and Global Trade (Seminar) *Contents*: Topic 1: Institutional Quality, Trade and Growth Topic 2: Aid for Trade Topic 3: Trade Facilitation Topic 4: Trade Agreements Topic 5: Trade and the Environment Topic 6: Technology and Trade Topic 7: Gender Inequality and Trade Topic 8: Trade, income per Capita and Inequality Topic 9: Trade and Transport Costs Topic 10: Trade and logistics Topic 11: Exchange Rate Volatility and Trade Topic 12: Financial Integration and Trade Topic 13: Trade and Conflicts Topic 14: The Extensive and the Intensive Margins of Trade Topic 15: Product Quality Topic 16: Multilateral Resistance and the Border Puzzle Topic 17: Geographical Frictions Topic 18: Trade and International Production Networks Topic 19: The Euro Effect Topic 20: Trade and Uncertainty	2 WLH
Examination: Presentation (approx. 20 min) with written elaboration (max. 15 pages text) **Examination prerequisites:** Regular active attendance.	

Examination requirements: International Trade	

Admission requirements: none	**Recommended previous knowledge:** International Economics Introductory econometrics
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0059: Methods of Economic Policy Evaluation**	6 C 3 WLH

Learning outcome, core skills:	**Workload:**
This course covers a wide range of policy impact evaluation tools: From experimental and quasi-experimental microeconometric methods to macroeconomic simulation models. The methods will be illustrated using case studies. The focus of the lecture will be on applications in the developing country context. The methods, however, are universal and can be applied as well in the context of OECD-countries. Please note that this lecture is held in German. Details and lecture materials can be found in StudIP. Some illustrative questions that can be answered using the methods that will be discussed in the lecture: • Do poor people really benefit from microcredtit programs? • What is the poverty impact of trade liberalisation? • Which are the distributional consequences of tax reforms?	Attendance time: 42 h Self-study time: 138 h

Courses:	
1. Methods of economic policy evaluation (Lecture)	2 WLH
2. Methods of economic policy evaluation (Tutorial)	1 WLH

Examination: Oral Presentation (approx. 30 minutes)	1 C

Examination: Written examination (90 minutes)	5 C

Examination requirements:	
Nachweis vertiefter Kenntnisse der Methoden zur Analyse wirtschaftspolitischer Maßnahmen und zur Datenerhebung. Nachweis des Verständnisses für experimentelle und quasi-experimentelle Methoden sowie von mikro- und makroökonomischen Simulationsmodellen.	

Admission requirements: none	**Recommended previous knowledge:** Lectures in Microeconomics, Development Economics and Econometrics
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Jann Lay
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0063: Sustainable Development, Trade and the Environment**	6 C 2 WLH
Learning outcome, core skills: • Linking sustainable development with trade. • Writing a scientific paper about the linkages between international trade, environment and development. • Reading and understanding state of the art literature in the field. • Discussing and scrutinizing methodology and results. • Presenting the own work in a scientific manner.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Sustainable Development, Trade and the Environment (Seminar)	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 20 pages) **Examination prerequisites:** Regular active attendance.	6 C
Examination requirements: Knowledge about the scientific themes.	

Admission requirements: none	**Recommended previous knowledge:** International Trade
Language: English	**Person responsible for module:** Prof. Dr. Inmaculada Martinez-Zarzoso
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0065: Economics of Crime**	6 C 2 WLH
Learning outcome, core skills: 1. Provide the theoretical and empirical framework that allows students to improve the understanding on the drivers of criminal participation and policies to deal with it. 2. Provide elements that allow students expand the traditional economic tool-bock to consider non-monetary factors that affect human behavior.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Economics of Crime (Lecture) This course presents a behavioral perspective to the economic model of crime. We discuss how different disciplines have understood criminal participation and consider how to model empirically the decision to engage into crime.	2 WLH
Examination: Written examination (90 minutes)	
Examination requirements: According to material in the course. Students should be able to derive the economic model of crime, introduce modification to it and make predictions on how this affects behaviour. Students should be able to understand the empirical limitations and problems on the empirical estimation of the model of crime and be able to discuss how limitations could be addressed.	

Admission requirements: none	**Recommended previous knowledge:** Microeonomics, Macroeconomics, Statistics, Econometrics
Language: English	**Person responsible for module:** Prof. Marcela Ibanez Diaz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3

Georg-August-Universität Göttingen Module M.WIWI-VWL.0083: Economic Reform and Social Justice in India	6 C 4 WLH
Learning outcome, core skills: This module deals with the economic transformation of India since 1991. The students • get to know the main features characteristic of the economic re-structuring of India during the past two decades • are familarised with the phenomenon of economic growth on the one hand and malnutrition and illiteracy on the other occurring simultaneously • acquire knowledge about the central public debates concerning social injustice and the possibility of government interventions.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Economic Reform and Social Justice in India (Lecture)** **2. Exercise course**	 2 WLH 2 WLH
Examination: Presentation (approx. 60 min) with written elaboration (max. 20 pages text)	6 C
Examination requirements: Ability • to demonstrate knowledge of the main features characteristic of the economic re-structuring of India during the past two deacdes; • to deal with the phenomenon of economic growth on the one hand and malnutrition and illiteracy on the other occurring simultaneously; • to describe the central public debates concerning social injustice and the possibility of government interventions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0085: Advanced Microeconomics	6 C 4 WLH
Learning outcome, core skills: This course presents a formal treatment microeconomic theory. Students learn how to formalize decision making by individual agents and strategic interaction. The course aims at provide students with the skills required to understand and develop new economic models.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Advanced Microeconomics (Lecture) *Contents*: • Consumer and production theory • General equilibrium • Decision under risk and uncertainty • Game theory	2 WLH
2. Advanced Microeconomics (Tutorial)	2 WLH
Examination: Written examination (120 minutes)	3 C
Examination requirements: Demonstrate the understanding of the main concepts and techniques developed in lectures. Ability to solve analytical exercises.	

Admission requirements: none	**Recommended previous knowledge:** BA level microeconomics and mathematics
Language: English	**Person responsible for module:** Prof. Marcela Ibanez Diaz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: not limited	

Additional notes and regulations: The courses "M.WIWI-VWL.0001: Fortgeschrittene Mikroökonomik" and "M.WIWI-VWL.0085: Advanced Microeconomics" are equal. Students can conclude only one of these courses.

Georg-August-Universität Göttingen Module M.WIWI-VWL.0086: Macroeconomics of Open Economies	6 C 4 WLH
Learning outcome, core skills: Understanding of macroeconomic issues in open economies	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Macroeconomics of Open Economies (Lecture)** **2. Macroeconomics of Open Economies (Tutorial)**	 2 WLH 2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Knowledge of open economy macro issues including the determinants growth, inflation, business cycles and capital flows	

Admission requirements: none	**Recommended previous knowledge:** BA level macroeconomics and econometrics
Language: English	**Person responsible for module:** Prof. Dr. Holger Strulik Dr. Timo Trimborn
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Additional notes and regulations:
The courses "M.WIWI-VWL.0002: Makroökonomik offener Volkswirtschaften" and "M.WIWI-VWL.0086: Macroeconomics of Open Economies" are equal. Students can conclude only one of these courses.

Georg-August-Universität Göttingen Module M.WIWI-VWL.0090: Seminar on Political Economy	6 C 2 WLH
Learning outcome, core skills: Based on academic papers, understanding different issues of political economy by writing and presenting an essay on one of the provided topics. Students are also required to attend and participate in the presentations of the other class members. Students improve their ability to answer a research question based on several academic papers and to present the ideas in a clear and logically structured way. They get familiar with some important issues in political economy.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar on Political Economy	2 WLH
Examination: Presentation (approx. 30 minutes) with written elobaration (max. 15 pages)	6 C
Examination requirements: Good understandig of the academic literature on the provided topic.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in microeconomics
Language: English	**Person responsible for module:** Refik Emre Aytimur
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 25	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0092: International Trade	6 C 4 WLH
Learning outcome, core skills: This course introduces the students to the core theoretical concepts explaining international trade patterns and various sources of trade flows like different technologies and factor endowments. Furthermore, the students learn about the gains and losses from international trade and the effect on factor prices and wages. In addition to the traditional explanations for trade patterns, recent approaches are introduced which are able to explain patterns that are observed today. Moreover, we discuss whether the predictions implied by theoretical models can be confirmed empirically.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. International Trade (Lecture)** **2. International Trade (Tutorial)**	 2 WLH 2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** Presentation of a group work (approx. 20 min)	6 C
Examination requirements: Demonstrate a profound knowledge of the core theoretical concepts in International Trade. Students should be able to assess the theoretical models with respect to empirical applications.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: not limited	

Additional notes and regulations: The courses "M.WIWI-VWL.0003: Reale Außenwirtschaft" and "M.WIWI-VWL.0092: International Trade" are equal. Students can conclude only one of these courses.

Georg-August-Universität Göttingen Module M.WIWI-VWL.0094: Geographical Economics	6 C 2 WLH

Learning outcome, core skills: The students are able to • understand the meaning of geographical aspects in economic theory • understand and determine structural characteristics, decisions of supply and demand, as well as adjustment dynamics to the long-run equilibrium within the core-periphery model and in various other models of economic geography • interpret tendencies of agglomeration, concentration and specialization in the European Union and in an international context • describe and explain agglomeration tendencies that occur due to the activity of multinational enterprises and foreign direct investments • explain world trade and economic growth with the models of economic geography and can differentiate the results from other models	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Geographical Economics (Lecture) *Contents*: • Geographical aspects in economic theory • The core-periphery model from Krugman and further models of economic geography • Agglomeration tendencies in the European Union and in an international context • Multinational enterprises, foreign direct investments and agglomeration • Agglomeration, the structure of world trade and economic growth	2 WLH

Examination: Written examination (90 minutes)	6 C

Examination requirements: Proof of knowledge of the theoretical foundations and applications of Geographical Economics and the achievement of the aims of the course.	

Admission requirements: none	**Recommended previous knowledge:** good BA-level knowledge in Mathematics, Microeconomics and Macroeconomics is strongly recommended and basic knowledge in Econometrics
Language: English	**Person responsible for module:** Dr. Astrid Krenz
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0095: International Political Economy**	6 C 3 WLH
Learning outcome, core skills: Understanding of mechanisms of direct and representative democracy, voting in international organizations, lobbying, collective action, economics of alliances, trade wars, trade negotiations, GATT and WTO, custom unions, free trade areas and the EU, protection for sale, globalization.	**Workload:** Attendance time: 42 h Self-study time: 138 h
Courses: **1. International Political Economy (Lecture)** *Contents*: Direct and representative democracy, voting in international organizations, lobbying, collective action, economics of alliances, trade wars, trade negotiations, GATT and WTO, custom unions, free trade areas and the EU, protection for sale, globalization.	 2 WLH
2. International Political Economy (Tutorial)	1 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Students have achieved a solid understanding of the mechanisms of direct and representative democracy, voting in international organizations, lobbying, collective action, economics of alliances, trade wars, trade negotiations, GATT and WTO, custom unions, free trade areas and the EU, protection for sale, globalization.	

Admission requirements: none	**Recommended previous knowledge:** Modul "International Trade"
Language: English	**Person responsible for module:** Prof. Dr. Holger Strulik
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0096: Essentials of Global Health**	6 C 2 WLH
Learning outcome, core skills: Comprehensive understanding of global health.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Essentials of Global Health (Lecture with Tutorial) *Contents*: The course will introduce students to the main concepts of the public health field and the critical links between global health and economic development. Students will get an overview of the determinants of health and how health status is measured. Students will also review the burden of disease, risk factors, and key measures to address the burden of disease in cost-effective ways. The course will be global in coverage but with a focus on low- and middle-income countries and on the health of the poor.	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 10 pages) **Examination requirements:** Comprehensive understanding of global health.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0099: Poverty & Inequality**	6 C 4 WLH

Learning outcome, core skills: This course provides an in-depth analysis of inequality, poverty and related economic issues at the graduate level. The course covers theories of justice, methodological aspects of poverty & inequality measurement, global aspects of poverty & inequality, effects of inequality on socio-economic outcomes, gender inequalities, inequality and poverty in rich countries as well as development policy targeting poverty. Some familiarity with development issues and empirical methods is highly desirable but not required. The course is open to M.A. students in development economics and international economics as well as graduate students from related fields.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Poverty & Inequality (Lecture)	2 WLH
2. Poverty & Inequality (Tutorial)	2 WLH

Examination: Practical examination with written elaboration (max. 5 pages) **Examination requirements:** Demonstrating skills related to the measurement of poverty and inequality. Demonstrating an understanding of the drivers and consequences of poverty and inequality and their interlinkages based on the most recent scientific literature.	2 C

Examination: Written examination (90 minutes) **Examination requirements:** Application of theoretical concepts to measure poverty and inequality using real data from a developing countries and statistical software like Stata.	4 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0100: Economics of Health Care Policy**	6 C 2 WLH
Learning outcome, core skills: • Students learn how to formulate research questions • Students have a close look at theoretical studies/arguments in related field	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Economics of Health Care Policy (Seminar) *Contents*: This seminar covers selected topics on the economics of health care policy. The seminar is structured in three parts. The first part introduces fundamental concepts of social justice, health equity and international health comparisons. The second part covers current issues of health care, health insurance and consumer behavior in high-income countries. The third part discusses challenges of health systems, the role of health workers, health care financing and challenges from major diseases in low-income countries.	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 10 pages text) **Examination requirements:**	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0105: Controversies in Development Economics	6 C 2 WLH
Learning outcome, core skills: The seminar addresses controversial issues in development economics. Such issues may be more topical (for example: Investments in agriculture and land: Land grab or development opportunity?) or more analytical (for example: The role of the state in economic development: Market-led development or interventionist models?). Based on the seminar papers, which will take a balanced stance toward a specific controversy, students will prepare a presentation that assumes a one-sided position during the seminar. Moderated discussions between two positions will be preceded and followed by a vote of the entire group to assess how convincing the respective presenter has made his or her argument. The seminar topics are subject to change every term.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Controversies in Development Economics	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 10 pages)	6 C
Examination requirements: Students will have to write a seminar paper, prepare a presentation, participate in the discussions and briefly discuss a paper of another student.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Jann Lay
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0108: Advanced Macroeconomics	6 C 4 WLH
Learning outcome, core skills: Understanding of the following topics: 1. Economic growth processes, in particular the role of investment, R&D and human capital 2. Real-business-cycle theory and policy, monetary policy 3. Fiscal Policy, in particular governmental taxes and budget deficits 4. Consumption and investment decisions	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. Advanced Macroeconomics (Lecture)	2 WLH
2. Advanced Macroeconomics (Exercises)	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Proving the ability to apply the mathematical tools and economic models discussed in the course to analyze: • the impact of investment, R&D subsidies and human capital accumulation on economic growth. • the causes of real-business-cycles and potential policies to influence them • the effects of monetary and fiscal policy • the determinants of individual consumption and investment decisions	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Holger Strulik
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0109: Recent Topics in Fiscal Policy**	6 C 2 WLH
Learning outcome, core skills: The students should learn to understand research papers related to recent topics in macroeconomic fiscal policy. They should be able to summarize, present and discuss these papers and relate them to the literature.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Recent Topics in Fiscal Policy (Seminar) *Contents*: In the seminar, recent research topics related to fiscal policy are discussed. The focus is on the macroeconomic impact of fiscal policy.	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 15 pages) **Examination prerequisites:** regular participation **Examination requirements:** Preparation of a seminar thesis related to one assigned topic, presentation of the topic, and discussion of another presenter's topic.	6 C

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Mathematics, and Econometrics as taught in the typical BA-courses. One master course covering a Macroeconomic topic is recommended.
Language: English	**Person responsible for module:** Dr. Timo Trimborn
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0110: Seminar in Regional and Urban Economics**	6 C 2 WLH

Learning outcome, core skills: The seminar covers theoretical models and empirical studies in the areas of Regional and Urban Economics and a field that has become known as the New Economic Geography. Students will gain a good understanding of current research topics in these areas and will moreover • gain the ability to read and understand literature related to current advances in Regional and Urban Economics and the New Economic Geography • learn how to develop coherent research questions • analyze their research question applying theoretical or empirical methodologies • practice their academic writing • improve their presentation and English skills.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar in Regional and Urban Economics (Seminar)	2 WLH
Examination: Presentation (approx. 20 min) with written elaboration (max. 15 pages)	
Examination requirements: The credits are given for the presentation and for the written paper on the same subject. In the presentation, the students demonstrate their ability to present complex theoretical models and empirical studies. In the paper, students demonstrate their ability to synthesize important findings from both theoretical models and empirical studies, to develop a sound research question based on the literature and to write a scientific paper.	

Admission requirements: none	**Recommended previous knowledge:** Modul “Geographical Economics”
Language: English	**Person responsible for module:** Dr. Astrid Krenz
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 14	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0112: Financial Markets and the Macroeconomy**	6 C 2 WLH
Learning outcome, core skills: Students acquire knowledge about the role of international financial markets for the macroeconomy. Further, students apply their statistical and econometric knowledge to relevant economic questions.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Financial Markets and the Macroeconomy (Seminar) *Contents*: The seminar focuses on the interdependences between financial markets and the macroeconomy. Motivated by the Great Recession, we discuss various channels through which financial markets may have an effect on real macroeconomic variables. Further, the international dimension of financial markets is highlighted, by discussing international transmission channels of financial shocks.	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: Scientific paper and solid presentation skills	

Admission requirements: none	**Recommended previous knowledge:** Basic econometrics and knowledge of open economy macroeconomics
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0113: Financial Econometrics**	6 C 4 WLH
Learning outcome, core skills: Students acquire and apply important econometric techniques in the area of international finance, macroeconomics, and financial. The focus will be on relevant applications rather than on statistical theory. Special emphasis will be placed on the development of programming skills in MATLAB. Students learn (i) how to work with real world data, (ii) how to set-up an econometric model in order to answer specific research questions, and (iii) how to present the results.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Financial Econometrics (Lecture)** *Contents*: a) Univariate time series modeling: ARMA models, Box-Jenkins approach, forecasting b) Multivariate models: simultaneous equations, Vector ARMA models c) Non-stationary time-series: unit roots, cointegration d) Modeling volatility: ARCH and GARCH models	 2 WLH
2. Financial Econometrics (Programming class) *Contents*: a) Introduction to MATLAB b) Working on programming exercises c) Working on empirical project	2 WLH
Examination: Written examination (60 minutes) **Examination prerequisites:** Practical examination and presentation (approx. 45 minutes)	6 C
Examination requirements: Students will work on an empirical project, writing their own MATLAB code to analyze real world data. Depending on the number of participants, students will work in groups. The results of the group work will be presented in front of the class. The exam covers contents of the lecture and the programming class.	

Admission requirements: none	**Recommended previous knowledge:** Econometrics I
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0114: Finance and Development**	6 C 4 WLH
Learning outcome, core skills: Upon completion of this course, students should have developed the capacity to comprehend and critically assess current theoretical and empirical research in the discussed fields.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. Finance and Development (Lecture)** *Contents*: The course focuses on the role of finance and financial markets for economic development in developing countries. The course consists of two parts. The aim of the *first part* of the course is to introduce students to basic concepts of financial markets, the role of financial institutions and financial decisions of households in developing countries. The *second part* focuses on analyzing specific aspects of household finance. It deals for instance, with risk and uncertainty, financial decisions of households, private savings, investments and insurances.	 2 WLH
2. Finance and Development (Tutorial)	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Good understanding of the discussed topics and the recommended literature.	

Admission requirements: none	**Recommended previous knowledge:** A profound knowledge of microeconomics and statistics.
Language: English	**Person responsible for module:** Dr. Ute Filipiak
Course frequency: unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0115: Topics in Public Economics**	6 C 2 WLH
Learning outcome, core skills: Students get familiar with current research areas and improve their knowledge on research methods. Further, they learn how to write a seminar paper and to present a topic in a clear and logically structured way.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Topics in Public Economics (Seminar) *Contents*: The students study topics in the field of public economics (e.g., taxation, public goods, economics of education, incentives of politicians, redistribution, media, and charitable giving).	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: Students are supposed to show good understanding of their topic and to present their work in a clear and concise way both in written and verbal form.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in microeconomics, econometrics, and public economics
Language: English	**Person responsible for module:** Refik Emre Aytimur Dr. Christian Bruns
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0116: Special Interest Politics**	6 C 2 WLH
Learning outcome, core skills: The course provides insights towards understanding interest-group politics from an incentive perspective, and the actual role played by SIGs in real political systems.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Special Interest Politics (Lecture) *Contents*: This course focuses on the mechanisms by which groups of pressure (e.g. lobbies) influence policy outcomes in modern democracies and/or in developing countries. Special interest groups (SIGs) are ubiquitous in U.S. politics and in the political systems of most countries. We will ask, and provide answers to, the following questions: What qualifies a voluntary association as a SIG? How do SIGs derive and consolidate their power and influence? Which channels (feasible strategies) do they exploit to bias policy outcomes to their favour? What happens when groups with differing objectives compete for influence? The course introduces and analyzes several theoretical tools (e.g. campaign giving, influence buying, informational lobbying), progressing from standard constructions to more complex frameworks.	2 WLH
Examination: Written examination (90 minutes)	6 C
Examination requirements: Good understanding of the techniques, methodologies and frameworks developed in the module, and ability to apply them to analyze economic questions related to the role of pressure groups and lobbies in the political arena.	

Admission requirements: none	**Recommended previous knowledge:** Microeconomic theory, Basic Game theory
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marco Maria Sorge
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0117: Growth, Resources, and the Environment**	6 C 4 WLH

Learning outcome, core skills: Students should learn how non-renewable resources, which are necessary in production, affect growth. Furthermore, they should learn how resource use affects the environment and which policy measures are suitable to mitigate environmental degradation. Finally, they should be able to investigate the interplay of renewable resources and growth.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Growth, Resources, and the Environment (Lecture)	2 WLH
2. Growth, Resources, and the Environment (Exercise)	2 WLH

Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Good understanding of the discussed topics and the recommended literature.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics and Mathematics
Language: English	**Person responsible for module:** Dr. Timo Trimborn Dr. Katharina Werner
Course frequency: every year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0118: Seminar on the Global Business Cycle**	6 C 2 WLH
Learning outcome, core skills: The seminar focuses on current topics associated with business cycle synchronization across countries. We discuss the co-movements of macroeconomic aggregates and analyze role of the globalization and region-specific factors. Therefore, we examine the question whether globalization results in a convergence of macroeconomic aggregates over time or whether those are rather decoupling, as proposed in the recent literature. Furthermore, we consider potential driving forces of an international business cycle.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar on the Global Business Cycle	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 15 pages) **Examination prerequisites:** regular participation	6 C
Examination requirements: The students should be able to elaborate on a recent topic independently. This process involves literature research, scientific work and writing and the appropriate oral presentation of the written paper.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Introductory Econometrics
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0119: Portfolios of the Poor**	6 C 2 WLH
Learning outcome, core skills: Upon completion of this course, students should have developed the capacity to comprehend and critically assess current theoretical and empirical research in the field of finance and development.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Portfolios of the Poor (Seminar) *Contents*: This seminar covers selected topics on household income, household financial spending and the economics of microfinance. The seminar is structured in two parts. The first part introduces fundamental concepts of money management, savings and portfolios of households in low-income countries. The second part covers current issues of micro finance and discusses challenges of financial risks, financial learning and the role of financial institutions. The course will discuss how individuals in developing countries manage their household finance and budgeting, while they live on very small incomes as well as it will look on how micro finance institutions provide financing for the poor.	2 WLH
Examination: Presentation (approx. 45 minutes) with written elaboration (max. 15 pages) **Examination prerequisites:** regular participation	6 C
Examination requirements: Good understanding of the theoretical concepts and empirical methods in the field of microfinance, and presentation of the academic literature.	

Admission requirements: none	**Recommended previous knowledge:** Modul "Development Economics I", Modul "Development Economics II", Modul "Econometrics I", Microeconomics
Language: English	**Person responsible for module:** Ute Filipiak
Course frequency: not specified	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0120: Dynamic Macroeconomics	6 C 2 WLH
Learning outcome, core skills: Students are expected to become familiar with highly sophisticated methodologies/frameworks through the lens of which scholars and policy institutions look at aggregate macroeconomic phenomena, such as business cycle fluctuations and the welfare effects of (monetary and/or fiscal) policy changes.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Dynamic Macroeconomics (Lecture) *Contents*: This course's aim is to introduce students to the recent literature on business cycle theory and econometrics. The course focuses on basic techniques for constructing, solving and estimating (linearized) Dynamic Stochastic General Equilibrium (DSGE) models, like e.g. the Kalman filter and Bayesian estimation. Topics include, but are not limited to, the following: i) Solving Rational Expectations (RE) models (e.g. Perturbation methods); ii) Identification of linearized DSGE models; v) Kalman filtering theory and ML estimation of linearized DSGE models.	2 WLH
Examination: Written Examination (90 minutes)	6 C
Examination requirements: Good understanding of the techniques, methodologies and frameworks developed in the module.	

Admission requirements: none	**Recommended previous knowledge:** Mathematics and Statistics, Basic Macroeconomics
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marco Maria Sorge
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0121: Seminar in Indeterminacy and Sunspots in Macroeconomics**	6 C 2 WLH

Learning outcome, core skills: Students are expected to become familiar with highly sophisticated methodologies/frameworks through the lens of which scholars and policy institutions look at aggregate macroeconomic phenomena, such as business cycle fluctuations and the welfare effects of (monetary and/or fiscal) policy changes.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Seminar in Indeterminacy and Sunspots in Macroeconomics *Contents*: This seminar covers theoretical foundations and empirical counterparts (quantitative aspects) of two topics which are central to modern macroeconomic theory: multiple (locally nonunique) equilibria and sunspots in stochastic dynamic models, and equilibirum selection in the presence of indeterminacy. In particular we will focus on (i) recent literature which exploits indeterminate equilibrium models to understand macroeconomic data and explain propagation mechanisms of business cycles and the transmission of policy changes; and (ii) different strand of scholarly work which aims at providing insight into the (possibly endogenous) mechanisms of equilibrium selection when indeterminacy arises.	2 WLH

Examination: Presentation (approx. 20 minutes) with written elaboration (max. 10 pages)	6 C

Examination requirements: Good knowledge of the topics and methodologies discussed in the Seminar, and ability to develop a research proposal. Depending on the number of participants, students may work in groups. Research proposals will also be presented in front of the class.	

Admission requirements: none	**Recommended previous knowledge:** Basic Macroeconomic theory
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Marco Maria Sorge
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0122: Seminar on Behavioral Development Economics**	6 C 2 WLH
Learning outcome, core skills: Students will: • Refresh concepts of micro-economic theory. • Undestand why the assumption of neoclassical micro economic models fail. • Learn alternative models that accommodate failures in rational decision making. • Understand the importance of using behavioral economic to study poverty and development.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar on behavioral development economics *Contents*: This course discusses how the behavioral approach can help to understand poverty and development and how it can be used for policy design. We discuss the advantages, limitations and potential of field experimental methods.	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 10 pages)	6 C
Examination requirements: In the presentation, the students demonstrate their ability to present complex theoretical models and empirical studies. In the paper, students demonstrate their ability to synthesize important findings from both theoretical models and empirical studies, to develop a sound research question based on the literature and to write a scientific paper.	

Admission requirements: none	**Recommended previous knowledge:** Micro-economics, Econometrics
Language: English	**Person responsible for module:** Prof. Marcela Ibanez Diaz
Course frequency: every winter term	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0123: Recent Topics in Macroeconomics**	6 C 2 WLH
Learning outcome, core skills: The students should familiarize with a recent macroeconomic topic and be able to summarize the academic discussion with respect to this topic. Furthermore, students should be able to critically discuss actual research with respect to this topic.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Recent Topics in Macroeconomics (Seminar) *Contents*: In the seminar a macroeconomic topic is investigated, which has attracted attention in academia recently and is subject to an ongoing academic debate.	
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: The students are required to summarize and explain one or two research papers, critically discuss the results, and relate the papers to research in that field.	

Admission requirements: none	**Recommended previous knowledge:** Mathematics, Macroeconomics
Language: English	**Person responsible for module:** Dr. Timo Trimborn
Course frequency: every summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 15	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0124: Seminar in Financial Econometrics	6 C 2 WLH
Learning outcome, core skills: Students acquire important econometric techniques including ARMA models, ARCH / GARCH models, simulation methods, and filtering methods. Further, students improve their skills in writing a seminar paper and presenting a topic in front of an audience.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar in Financial Econometrics *Contents*: This seminar covers topics in time series analysis with an emphasis on applications in macroeconomics, international finance, and financial economics. The focus will be on both the statistical theory as well as relevant applications in macroeconomics and finance.	2 WLH
Examination: Presentation (approx. 20 minutes) with written elaboration (max. 15 pages) **Examination prerequisites:** regular participation.	6 C
Examination requirements: The students should be able to elaborate on a topic independently. This process involves literature research, scientific work and writing and the appropriate oral presentation of the written paper.	

Admission requirements: none	**Recommended previous knowledge:** Econometrics I
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0125: Global Health	6 C 2 WLH
Learning outcome, core skills: At the end of the course, students will be able to 1. Analyze the relationships between global health, population dynamics and human and economic development, using key concepts in these fields of study 2. Critically evaluate academic articles and policy reports on population and global health issues 3. Synthesize and present texts on global health in verbal discussion, oral presentation, and written briefs 4. Produce research papers that present balanced, thoughtful, and well-evidenced arguments on topics in global health and population.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Global Health (lecture) *Contents*: Individual vs. Population Health; Global Burden of Disease; Evaluation of Global Health Interventions I; Evaluation of Global Health Interventions II; Wealth and Health of Nations; Social Determinants of Health; Health Systems and Financing; Global Health Governance and Management	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Comprehensive understanding of global health.	4 C
Examination: Essay (max. 2 pages) **Examination requirements:** Comprehensive understanding of global health.	2 C

Admission requirements: none	**Recommended previous knowledge:** Understanding of basic concepts and strong interest in global health, sound methodological skills.
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: irregular (every 2-3 semester)	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 40	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0128: Deep Determinants of Growth and Development**	6 C 2 WLH
Learning outcome, core skills: Students should acquire a deeper understanding of the mechanisms that lead to long-run economic development. They should learn about the forces that are linked to economic development like demography, education, and fundamental determinants of economic growth like culture, institutions, geography.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Deep Determinants of Growth and Development (Lecture) *Contents*: In this course we will study long-run trends in economic development. We will analyze questions such as • Why are some countries richer than others? • Why is a country today richer than several generations ago? • How can historical events affect the economy today? • What are the mechanisms that lead to the transition from stagnation towards sustained growth? In particular, the students should learn about the forces that are linked to economic development like demography, education, and fundamental determinants of economic growth like culture, institutions, geography	2 WLH
Examination: Oral exam (approx. 20 minutes) or written exam (90 minutes)	6 C
Examination requirements: Good understanding of the discussed topics and the recommended literature.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Mathematics for Economists, Economic Growth, Econometrics as taught in the Bachelor courses
Language: English	**Person responsible for module:** Dr. Katharina Werner
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0130: Seminar in Gender Differences in Labor Economics**	6 C 2 WLH

Learning outcome, core skills: Students will • gain the ability to read and understand literature on gender differences on labor markets • develop of research questions • analyze these questions by applying experimental and empirical methods • learn how to critically assess of other seminar papers • practice their academic writing • improve their presentation and English skills.	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: Seminar in Behavioral Finance (Seminar) *Contents*: The seminar covers experiments and empirical studies in the areas of Behavioral Economics, Organizational Economics, and gender differences on labor markets. Students will gain an understanding of current research. In this regard they are presented to state of the art research papers.	2 WLH

Examination: Presentation of another paper (approx. 5 minutes)	1 C

Examination: Presentation (approx. 20 minutes) with written elaboration (max. 15 pages)	5 C

Examination requirements: The credits are awarded for the seminar paper and the presentation which includes the discussion of the own seminar paper and a paper of another student. In the presentation, the students demonstrate their ability to present complex experiments and empirical studies. In the seminar paper, students demonstrate their ability to synthesize important findings from both empirics and experiments.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in Game Theory and Behavioral Economics
Language: English	**Person responsible for module:** Jun.-Prof. Dr. Holger A. Rau
Course frequency: every second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0131: Business Cycles in Developing Countries**	6 C 2 WLH
Learning outcome, core skills: The seminar focuses on current topics associated with business cycles in developing countries. Business cycles in developing countries display different characteristics than those in their developed counterparts. We therefore discuss the transmission of shock in developing countries and whether stabilizing policies be different compared to developed countries. Moreover, we examine whether the extent to which business cycles in developing countries are explained by global, regional, country-specific, and idiosyncratic factors, is different compared to developed countries. The focus of this seminar will be on the empirical rather than the theoretical literature.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Business Cycles in Developing Countries (Seminar)	2 WLH
Examination: Presentation (approx. 20 min.) with written elaboration (max. 15 pages)	6 C
Examination requirements: The students should be able to elaborate on a recent topic independently. This process involves literature research, scientific work and writing and the appropriate oral presentation of the written paper.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Introductory Econometrics
Language: English	**Person responsible for module:** Prof. Dr. Tino Berger
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0132: New Developments in International Economics**	6 C 2 WLH
Learning outcome, core skills: The students should familiarize with a recent topic in international economics and should be able to summarize the academic discussion with respect to this topic. Furthermore, students should be able to critically discuss actual research with respect to this topic.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: New Developments in International Economics (Seminar) *Contents*: In the seminar a topic in international economics is investigated, which has attracted attention in academia recently and is subject to an ongoing academic debate.	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 15 pages) **Examination requirements:** The students are required to summarize and explain one or two research papers, critically discuss the results, and relate the papers to research in that field.	5 C
Examination: Presentation (approx. 5 minutes) **Examination requirements:** Discussion of topic presented by a fellow student.	1 C

Admission requirements: none	**Recommended previous knowledge:** Mathematics, Macroeconomics, Econometrics
Language: English	**Person responsible for module:** Prof. Dr. Holger Strulik
Course frequency: unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0134: Development Economics of Innovations**	6 C 2 WLH
Learning outcome, core skills: Upon completion of this course, students should have developed the capacity to comprehend and critically assess current theoretical and empirical research in the field of development economics of innovation.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Development Economics of Innovations (Seminar) *Contents*: This seminar covers selected topics on economics of innovations in developing countries. The seminar is structured in two parts. The first part introduces fundamental concepts of conditions and constraints for technological adoption and innovation processes, in low-income countries. The second part covers current issues of innovation incentives of firms, the effects of innovations on market structure, and intellectual property rights. The course will discuss how households act as adopters of innovations and specific aspects of the innovation processes of firms. The seminar will discuss the aforementioned topics in different markets, e.g. in the agricultural sector but also in other markets. Some of the given topics have a focus on South Asia.	2 WLH
Examination: Presentation (ca. 45 minutes) with written elaboration (max. 15 pages)	6 C
Examination requirements: Good understanding of the theoretical concepts and empirical methods in the field of development economics of innovation and presentation of the academic literature.	

Admission requirements: none	**Recommended previous knowledge:** Modul "Development Economics I", Modul "Development Economics II", Modul "Econometrics I", Microeconomics
Language: English	**Person responsible for module:** Ute Filipiak
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0135: Advanced Economic Growth**	6 C 4 WLH

Learning outcome, core skills: Students should acquire a deeper understanding of the mechanisms that lead to long-run economic development. They should familiarize with the standard growth models and should learn about the driving forces of modern economic growth like capital accumulation, human capital and technology.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Advanced Economic Growth (lecture) *Contents*: In this course we will study long-run trends in economic development. We will analyze questions such as • Why are some countries richer than others? • Why do some countries grow more rapidly than others? • What are the engines of economic growth? • What are the mechanisms that lead to sustained economic growth? In particular, the students should learn about the engines of modern economic growth, like capital accumulation, human capital and technology.	2 WLH
2. Advanced Economic Growth (tutorial)	2 WLH

Examination: Oral examination (20 minutes) or written examination (90 minutes)	6 C

Examination requirements: Good understanding of the discussed topics and the recommended literature.	

Admission requirements: none	**Recommended previous knowledge:** Macroeconomics, Mathematics for Economists, Economic Growth, Econometrics as taught in the Bachelor courses
Language: English	**Person responsible for module:** Dr. Katharina Werner
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0137: Seminar Games in Economic Development**	6 C 2 WLH
Learning outcome, core skills: This seminar course aims at examining development issues through the use of elementary game theory. Participants are expected to give a presentation on a pre-assigned reading. Based on this reading is expected that students critically asses the state of the art and suggest new research ideas.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar Games in Economic Development (Seminar) *Contents*: • Development traps and coordination games • Rural poverty development and the environment • Risk, solidarity networks and reciprocity • Agrarian Institutions • Savings, Credit and Microfinance • Social Learning and Technology Adoption • Property right, governance and corruption • Conflict, violence and develpment • Social capital	2 WLH
Examination: Presentationen (ca. 40 minutes) with written elaboration (max. 5 pages)	6 C
Examination requirements: Present the selected reading and provide a critical assessment of the topic and suggestion of further avenues of research.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Marcela Ibanez Diaz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 18	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0138: Quasi-Experiments in Development Economics**	6 C 4 WLH

Learning outcome, core skills: Students will learn about and be able to apply the most important statistical techniques for causal inference in development contexts and beyond.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Quasi-Experiments in Development Economics (Lecture with tutorials) *Contents*: The course deals with common quasi-experimental approaches for measuring causal effects in developing economics. The content focuses on the distinction between correlation and causality and provides students with a statistical toolkit which will allow them to plan and conduct their own independent research. Special attention will be paid to the specific assumptions necessary for each technique to measure causal effect and common threats to identification (such as selection bias). Students will learn how to use quasi-experimental techniques in a very practical manner through the replication of existing work, writing referee reports and drafting their own research proposal using the attained skills.	4 WLH

Examination: Written examination (90 minutes)	

Examination: Practical examination	6 C

Examination requirements: • Comprehensive theoretical and practical understanding of causal identification and the major methods. • Practical implementation with Stata.	

Admission requirements: none	**Recommended previous knowledge:** Basic understanding of statistics and econometrics
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0139: Seminar on the Economics of the European Union**	6 C 2 WLH
Learning outcome, core skills: Students will • gain the ability to read and understand the literature in European Economics • get a good knowledge of basic theories and recent developments in the field • analyze a chosen topic applying theoretical or empirical methodology • practice their academic writing and oral presentation skills in English.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Seminar on the Economics of the European Union (Seminar) *Contents*: The seminar deals with theoretical and empirical studies in European Economics and covers aspects of European integration, the European Monetary Union, trade, competition and industrial policies, European structural and regional policies and labor market effects.	2 WLH
Examination: Presentation (approx. 20 min) with written elaboration (max. 15 pages)	6 C
Examination requirements: The credits are given for the presentation and for the written paper on the same subject. In the presentation, the students demonstrate their ability to present basic theories and empirical results in European Economics. In the paper, students demonstrate their understanding of the models and methods in European Economics and write a scientific paper on a given topic.	

Admission requirements: none	**Recommended previous knowledge:** International Trade
Language: English	**Person responsible for module:** Dr. Astrid Krenz
Course frequency: each second semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 14	

Georg-August-Universität Göttingen Module M.WIWI-VWL.0140: Economics of Education	6 C 4 WLH
Learning outcome, core skills: This course will help students build knowledge and understanding about the economics of education, especially on issues from the developing countries. It will familiarize them with the existing literature and prepare them for independent research in this area.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Economics of Education *Contents*: • Human capital and signaling models • Private and social returns to education • Education production function • Teachers: teacher labour market, teaching quality, etc. • Students: peer effects, tracking, etc. • Equity aspects: gender gap, affirmative action, etc. • School choice: private and public investments in education • Role of cognitive versus non-cognitive skills in labour market outcomes	4 WLH
Examination: Written examination (90 minutes)	3 C
Examination: Presentation (ca. 30 minutes) with written elaboration (max. 5 pages)	3 C
Examination requirements: Students demonstrate a good understanding of the theory and empirical models related to the economics of education. They are able to critically evaluate existing research to draw policy relevant conclusions and identify open areas for further research in this field.	

Admission requirements: none	**Recommended previous knowledge:** Basics of microeconomics and econometrics
Language: English	**Person responsible for module:** Dr. Sarah Khan, Dr. Soham Sahoo
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0141: The economics of information and Internet**	6 C 4 WLH
Learning outcome, core skills: The goal of this unit is to introduce a number of economic concepts and tools to understand and solve issues involved in producing and marketing information goods, in building networks of buyers and sellers online and in intermediating economic and intellectual exchanges. The students should come out of this unit with a better understanding of issues faced by economic actors online, with the ability to understand academic research on this topic and with the capacity to understand and develop business strategies adapted to this setting.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses:	
1. The economics of information and Internet (Lecture) *Contents*: This unit deals with the economics of the production and distribution of information goods on the Internet. It will analyze the production, pricing and distribution of products that are mainly informational in nature such as software and news. It will also present the structure and functioning of Internet-mediated markets as well as models of production that are specific to the Internet. Lecture Outline: 1. Information goods: pricing, bundling, versioning, sampling, reputation. 2. Models of consumer search for goods and information online. 3. Intermediation, network effects and platform competition. 4. Open source software and the collaborative production of information goods.	2 WLH
2. The economics of information and Internet (Exercise) *Contents*: Exercises will focus on analyzing specific aspects of the strategies of a range of Internet companies, as exposed in recent published academic articles.	2 WLH
Examination: Written examination (90 minutes) **Examination requirements:** The exam will consist of half simple exercises and half knowledge questions.	4 C
Examination: Essay (max. 15 pages) **Examination requirements:** The essay will consist of the analysis of the business model of a company involved in business online, its competitive environment and the specific economic problems it faces.	2 C

Admission requirements: none	**Recommended previous knowledge:** Microeconomics, game theory
Language:	**Person responsible for module:**

English	Dr. Alexia Gaudeul
Course frequency: once a year	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0142: Seminar: Central banking in a global economy**	6 C 2 WLH
Learning outcome, core skills: The seminar deals with institutional and monetary policy designs of the major central banks worldwide. Specifically, the focus is on the functioning and effectiveness of monetary policy approaches of the US Federal Reserve, the ECB, the Bank of Japan, the Bank of England, and the Peoples Bank of China. In front of the crucial impact of central banks on the real economy, it is essential to understand their goals, the decision-making process and the channels of their influence.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Central banking in a global economy (Seminar)	2 WLH
Examination: Presentation (ca. 20 minutes) with written elaboration (max. 15 pages)	
Examination requirements: Independent research work on one seminar-related issue, resulting in an essay; presentation of the essay	

Admission requirements: none	**Recommended previous knowledge:** Advanced macroeconomics
Language: English	**Person responsible for module:** Agnieszka Gehringer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0143: Mind, Society and Development**	6 C 2 WLH
Learning outcome, core skills: This seminar would allow students to build on knowledge gained in the course behavioral development economics. Students will learn how behavioral economic models can be used to understand development and design development policies. Students are expected to do a critical assessment of existing literature. Identify gaps in research and suggest future research questions.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Behavioral Economics (Seminar)	2 WLH
Examination: Presentation (ca. 30 minutes) with written elaboration (max. 10 pages) **Examination prerequisites:** Active in discussion	
Examination requirements: All students are required to write a 10 page term paper doing a critical assessment of recent developments on the topic. Participants are expected to explain findings of key papers on the topic, discuss the limitations of the papers and suggest future areas of research. It is expected that students attend presentations of the peers and participate actively in the discussion.	

Admission requirements: none	**Recommended previous knowledge:** Microeconomic; Statistics, Econometrics
Language: English	**Person responsible for module:** Prof. Marcela Ibanez Diaz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0144: International economic policy: Replication course**	6 C 4 WLH
Learning outcome, core skills: The course addresses selected issues of international economic policy using methods of applied econometrics. By reading, discussing and re-estimating empirical papers on the topic, students should learn how to address politically relevant issues with the help of applied empirical analysis. They will train how to define a research question, how to deal with issues of causal identification and model selection, how to perform an empirical analysis and how to interpret the empirical results.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Courses: **1. International economic policy** (Lecture) *Contents*: The lecture discusses empirical papers on selected issues of international economic policy (including selected questions on trade, migration, and other alternating globally relevant issues).	 2 WLH
2. International economic policy (Exercise) *Contents*: The exercise sessions focus on re-estimating selected empirical papers in a structured way, using statistical software.	2 WLH
Examination: Practical examination with written elaboration (max. 15 pages) **Examination prerequisites:** Up to ten short weekly hand-ins (code and/or explanations, max. half page each) will be due during the course. Admission to the exam will require a successful collection of at least 50% of all points achievable in the exercises.	
Examination requirements: The practical examination consists of performing and documenting an empirical analysis on a pre-defined topic related to the focus of the course. The written documentation should explain and discuss the empirical analysis.	

Admission requirements: none	**Recommended previous knowledge:** Econometrics 1 and 2 / Causal inference in economics
Language: English	**Person responsible for module:** Prof. Dr. Krisztina Kis-Katos
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 4
Maximum number of students: 20	

Additional notes and regulations: Participation is limited by the practical module examination.

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0145: European Economics**	6 C 2 WLH

Learning outcome, core skills: The students • are able to understand and explain different economic theory and empirical models in European Economics • get a good knowledge of basic theories and recent developments in the field • are able to determine structural characteristics, decisions of supply and demand, as well as adjustment dynamics to the long-run equilibrium within various models in European Economics • learn about different policies in the European Union, i.e. European Monetary Policy, Regional Policy, Trade Policy, and Agricultural Policy • are able to interpret the linkages between the history and institutions of the European Union and its standing in international relations, in European enlargement strategies and in the migration debate	**Workload:** Attendance time: 28 h Self-study time: 152 h

Course: European Economics (Lecture) *Contents*: The Lecture covers several topics in European Economics. We will deal with the history and institutions of the European Union, growth aspects, European Monetary and Regional Policy, as well as Trade, Science and Technology, Competition and Agricultural Policy. Moreover, the European Labor Market and Environmental Issues will be investigated. Recent issues covering the European Union and its standing in International Relations, the challenges of European Enlargement, the demands during the Financial Crisis as well as recent developments due to the Migration towards the European Union will be examined.	2 WLH

Examination: Written examination (90 minutes)	

Examination requirements: Proof of knowledge of the theoretical foundations and applications of European Economics and the achievement of the aims of the course.	

Admission requirements: none	**Recommended previous knowledge:** Good BA-level knowledge in Mathematics, Microeconomics and Macroeconomics is strongly recommended and basic knowledge in Econometrics. Prior knowledge in International Trade is advised.
Language: English	**Person responsible for module:** Dr. Astrid Krenz
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module M.WIWI-WB.0001: Scientific Programming	3 C 1 WLH

Learning outcome, core skills: The students • know the basic structure and operations of the programming environment MATLAB as well as the most important methods for programming with matrices. • learn the basic concepts and ways of thinking in scientific programming. • learn how to efficiently make use of advanced development tools such as the debugger and the profiler. • are able to visualize problems and create professional graphics. • are able to independently solve problems in MATLAB by their own programming – for example as part of a scientific paper.	**Workload:** Attendance time: 18 h Self-study time: 72 h

Course: Scientific Programming (Computer Exercise) *Contents*: The practical computer course provides a fundamental introduction to scientific programming with the statistical software “MathWorks MATLAB”. Using the Basic programming language is a great way to teach the essential concepts of programming and numerical data processing, and it allows students to acquire skills required in quantitative sciences. Modern lecture slides available in German and English languages, which include practical exercises, are used. By using the course material, the participants will be motivated to focus on the concepts, and they will be able to track their own progress during the course. Topics 1. Graphical User Interface 2. Data and Operations 3. Functions 4. Programming Concepts 5. Development Tools 6. 2D- und 3D-Graphics 7. Advanced Solving Algorithms	1 WLH

Examination: Written examination (60 minutes) or oral examination (approx. 15 minutes) **Examination prerequisites:** Active participation	3 C

Examination requirements: Knowledge of the usage and functionality of MathWorks MATLAB. Application of MATLAB’s built-in operations and functions. Knowledge of importing, processing and statistical analysis of data. Solving short – even graphical – programming tasks. Knowledge of programming concepts such as loops and branches. Knowledge of a “good programming style”.	

Admission requirements:	**Recommended previous knowledge:**

none	Mathematics and statistics
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.WIWI-WB.0005: Advanced Topics in Stata**	3 C 2 WLH
Learning outcome, core skills: At the end of the course students will • be experts at using basic data manipulation commands and creating well formatted output • be proficient with basic programming skills (using macros, looping and branching) • have a good understanding of the particularities of survey data and know how to analyze it • be able to debug any Stata code • know how to extend Stata by writing own subroutines, such as estimation or postestimation commands • be experienced with fundamentals of Mata programming	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Advanced Topics in Stata (Computer lab session) *Contents*: The course will first refresh participants' knowledge regarding the basic functions of Stata and then cover advanced topics, such as working with survey data, debugging, programming and Stata's matrix language Mata.	2 WLH
Examination: Practical examination	3 C
Examination requirements: The course will first refresh participants' knowledge regarding the basic functions of Stata and then cover advanced topics, such as working with survey data, debugging, programming and Stata's matrix language Mata.	

Admission requirements: none	**Recommended previous knowledge:** Introduction to Stata, basic understanding of econometrics
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-WB.0006: Introduction to Geographic Information Systems**	6 C 3 WLH

Learning outcome, core skills: Students know the fundamentals of Geoinformation Systems and can apply GIS tools and techniques for selected ‘real-world’ applications.	**Workload:** Attendance time: 42 h Self-study time: 138 h

Course: Introduction to Geographic Information Systems (Block course) *Contents*: • Structure of Geographic Information Systems • Data formats and data management • Acquisition of Spatial data • Thematic cartography and geographic visualisation • Data analysis – principles and applications • Introduction to terrain and image analysis • Presentation of applied GIS projects	3 WLH

Examination: Project with presentation (approx. 20 minutes)	6 C

Examination requirements: Students will have to complete and present a project.	

Admission requirements: none	**Recommended previous knowledge:** Good general computer knowledge
Language: English	**Person responsible for module:** Dr. Daniel Wyss
Course frequency: irregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-WB.0009: Introduction to Qualitative Health Research in Low-and-Middle-Income Countries**	3 C 2 WLH
Learning outcome, core skills: The goal of this course is to provide students with the knowledge and skills needed to conceptualize and conduct a rigorous qualitative research project focused on health in low and middle income countries. By the end of the course, students will be able to: • Describe the theoretical foundations of qualitative research • Describe the fundamentals of varying qualitative methods, including their strengths and limitations • Define and discuss the importance of qualitative research for the public health in low and middle income countries • Demonstrate familiarity with key approaches to analysing qualitative data • Appreciate how qualitative research can be used to facilitate social change • Write a clear and well-conceptualised qualitative research proposal	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Introduction to Qualitative Health Research in Low-and-Middle-Income Countries (Seminar) *Contents*: Qualitative research represents an important approach within public health and makes unique contributions to the understanding of health experiences and outcomes, as well as the impacts of public health programs and interventions. Highlighting qualitative methods in low-and-middle-income countries (LMIC), this course will provide students with a strong foundation regarding qualitative methods through a comprehensive overview of diverse types of qualitative research and key approaches to analyzing qualitative data. The theoretical and philosophical foundations underlying qualitative approaches will be covered, as will key methods including ethnography/participant-observation, qualitative interviews, focus group discussions, and survey research and questionnaire development. The course will highlight the potential of qualitative methods to contribute to interdisciplinary or mixed-methods research focused on health experiences and outcomes. Applied learning opportunities will be emphasised to help prepare students to conduct future qualitative health research. Two 2-hour sessions each week in a seminar and tutorial format. Required readings will be critically assessed through facilitated group discussions. Some of the group discussions will be student-led and each student will be responsible for being the primary discussant for at least 1 reading over the course of the semester. Tutorials will provide students with the opportunity for experiential hands-on learning, as we will be practicing the tools learned during the seminar.	2 WLH
Examination: Term paper (max. 15 pages)	
Examination requirements: Students will be required to write a research proposal for a qualitative or mixed-methods research study in a LMIC on the topic of their choice. The proposal should contain all	

of the elements required to describe a proposed qualitative study in detail including: introduction, background, research problem, research objectives or question, methods of data collection and analysis.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Siobhan Doria
Course frequency: unregular	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 4
Maximum number of students: 25	

Georg-August-Universität Göttingen Module M.WIWI-WIN.0001: Modeling and System Development	6 C 2 WLH
Learning outcome, core skills: Upon successful completion, students are able to • describe and explain the principles and elements of modeling techniques and design possibilities of systems • apply selected methods for modeling systems independently, • select an appropriate method for modeling a task and delineate versus the benefits of other methods, • outline the development of systems in the business environment and to evaluate and to transfer this to related situations, • analyze and reflect critically selected current trends in the field of system development in group work and • work in groups on tasks with the help of acquired communication and organizational skills.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Modeling and System Development (Lecture) *Contents*: • Basics • System survey • Process modeling • Object modeling • Design of systems • Implementation • Integration of systems • Quality management in system development • Configuration management • Cost estimate of system developments	2 WLH
Examination: Written examination (120 minutes) **Examination prerequisites:** successfully passed term paper and case study (max. 12 pages) **Examination requirements:** Students show in the exam that they • can explain, evaluate and apply theories and concepts for modeling processes, application systems and software, evaluate and apply, • can explain and assess what they learned in the lectures regarding aspects of system development , • can analyze complex problems in system development in a short time and can identify both challenges and solutions, • are able to transfer the approaches teached in the lectures to similar problems.	6 C

Admission requirements:	Recommended previous knowledge:
none	none

Language: English	**Person responsible for module:** Prof. Dr. Matthias Schumann
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.WIWI-WIN.0004: Crucial Topics in Information Management**	12 C 2 WLH
Learning outcome, core skills: The students: • know the state of the art as well as future challenges regarding a current research theme in Information Management • have profound knowledge within the research field they worked upon • know and understand methods and approaches in order to elaborate on Information Management topics in a scientific manner • can elaborate research questions systematically by means of scientific methods	**Workload:** Attendance time: 28 h Self-study time: 332 h
Course: Crucial Topics in Information Management (Seminar)	2 WLH
Examination: Presentation (approx. 30 minutes) with written elaboration (max. 8000 words) **Examination prerequisites:** regular attendance; participation on possibly excursions.	12 C
Examination requirements: • Scientific and solution-oriented elaboration of current topics in Information Management • Writing a seminar paper • Oral presentation of the seminar paper's findings • Collaboration with other students in teams	

Admission requirements: none	**Recommended previous knowledge:** Modul "Informationsmanagement"
Language: English	**Person responsible for module:** Prof. Dr. Lutz M. Kolbe
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen **Module M.WIWI-WIN.0008: Change & Run IT**	6 C 4 WLH

Learning outcome, core skills: The students • know the central differences between production and service provision as well as the possibility of bundling both areas to hybrid products, • know the fundamentals and key concepts of IT service management and information management, • know the contents of the ITIL framework and its core elements in detail: • service strategy • service design • service transition • service operation • continual service improvement • participate in the business simulation Fort Fantastic, and thereby learn about different aspects of application scenarios for the ITIL- and other management frameworks, • know the success factors of (IT-) project management, • have a fundamental knowledge of the two basic project management frameworks PRINCE2 und PMBoK, • know tools and methods of project management, e.g. critical path method and gantt chart, • are able to critically reflect on the concepts and methods of IT service management and project management, apply these to concrete problems and document them.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Change and Run IT (Lecture)	2 WLH
2. Change and Run IT (Tutorial)	2 WLH

Examination: Written examination (120 minutes) **Examination prerequisites:** Participation in the simulation game Fort Fantastic. The attendance of guest lectures which may be part of the module are obligatory and are considered as precondition to take the examination.	6 C

Examination requirements: In the module examination, the students demonstrate that they are able to reproduce fundamental knowledge and basic concepts of IT service management and project management. Besides, they are able to apply acquired knowledge within case studies in a solution-oriented manner. In particular, this includes transferring knowledge from the ITIL framework to different fields of application and the utilization of IT service management methods. In addition, the students are able to critically assess the proposed procedures and adapt these to specific problem areas.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Lutz M. Kolbe
Course frequency: every semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 2
Maximum number of students: 50	

Additional notes and regulations:
The module is offered in each semester. In the summer term, lecture and tutorial take place regularly, whereas in the winter term only the tutorial is offered and the lecture has to be prepared through self-study which is based on the recorded lecture of the respective previous summer semester.

Georg-August-Universität Göttingen **Module M.WIWI-WIN.0019: Business Intelligence and Decision Support Systems**	6 C 3 WLH

Learning outcome, core skills: • This course aims to enable students to understand the basic principles of business intelligence (BI) and decision support systems (DSS). • Provide a skillset suited for addressing unstructured decision situations that require advanced data processing and analysis. • Give an overview of methods and tools required in modern performance reporting. • Provide an introduction to data visualization and the application / value of these methods. • Provide an understanding of how to apply data and text mining methods.	**Workload:** Attendance time: 42 h Self-study time: 138 h

Courses:	
1. Business Intelligence and Decision Support Systems (Lecture) *Contents*: • Conceptual, methodological and technical foundations of BI and DSS. • Decision support processes and their phases. • System components needed for the collection, analysis and visualization of structured and unstructured, as well as semi-structured data. • Data and text mining methods such as decision trees, neural networks and support vector machines.	2 WLH
2. Business Intelligence and Decision Support Systems (Tutorial)	1 WLH

Examination: Written examination (90 minutes) **Examination requirements:** Students have to demonstrate profound knowledge of the theoretical and methodological foundations of the material. They have to show an understanding of relevant system components providing managerial decision support.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Jan Muntermann
Course frequency: every winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2 - 3
Maximum number of students: not limited	

Georg-August-Universität Göttingen Module SK.Bio-NF.7001: Neurobiology	3 C 2 WLH
Learning outcome, core skills: The students should acquire comprehension in form and function of neurons and their anatomical and physiological features (genetics, subcellular organization, resting membrane potential, action potential generation, stimulus conduction, transmitter release, ion channels, receptors, second messenger cascades, axonal transport). The students acquire knowledge of the physiological basics of sensory systems (olfactory, gustatory, acoustic, mechanosensory and visual perception) as well as motor control. Based on this the students educe understanding for the relation between neuronal circuits and simple modes of behavior (central pattern generators, reflexes, and taxis movements). The students should conceptually learn how neuronal connections are modified by experience (cellular mechanisms of learning and memory) and should learn different types of modification of behavior based on experience and neuronal substrates. The students should acquire fundamental insight into the organization and function of brains and autonomous nervous systems of mammals and invertebrates. The neurobiological basis of behavioral control (orientation, communication, circadian rhythm and sleep as well as motivation and metabolism) is explained. The students will learn physiological and cellular mechanisms of aging and of neurodegenerative diseases.	**Workload:** Attendance time: 30 h Self-study time: 60 h
Course: Neurobiology (Lecture)	2 WLH
Examination: Written examination (90 minutes)	3 C
Examination requirements: The students should have the ability to assess coherence and facts of statements from the field of neurobiology; they should be able to answer questions on the structure and function of neurons and neuronal circuits. Furthermore they should be able to describe and compare neuronal basics of behavioral control, their experience-dependent modification and conceptual mechanisms of complex behavior; they should be able to describe and compare physiological mechanisms of sensory perception and different sensory modalities; they should be able to describe physiological and cellular mechanisms of aging and of neurodegenerative diseases.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in Biology
Language: English	**Person responsible for module:** Prof. Dr. Andre Fiala
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module SK.Bio.7001: Neurobiology**	6 C 4 WLH
Learning outcome, core skills: The students should acquire comprehension in form and function of neurons and their anatomical and physiological features (genetics, subcellular organization, resting membrane potential, action potential generation, stimulus conduction, transmitter release, ion channels, receptors, second messenger cascades, axonal transport). The students acquire knowledge of the physiological basics of sensory systems (olfactory, gustatory, acoustic, mechanosensory and visual perception) as well as motor control. Based on this the students educe understanding for the relation between neuronal circuits and simple modes of behavior (central pattern generators, reflexes, and taxis movements). The students should conceptually learn how neuronal connections are modified by experience (cellular mechanisms of learning and memory) and should learn different types of modification of behavior based on experience and neuronal substrates. The students should acquire fundamental insight into the organization and function of brains and autonomous nervous systems of mammals and invertebrates. The neurobiological basis of behavioral control (orientation, communication, circadian rhythm and sleep as well as motivation and metabolism) is explained. The students will learn physiological and cellular mechanisms of aging and of neurodegenerative diseases.	**Workload:** Attendance time: 30 h Self-study time: 150 h
Courses:	
1. Neurobiology (Lecture)	2 WLH
2. Neurobiology (Seminar)	2 WLH
Examination: Written examination (90 minutes) **Examination prerequisites:** regular seminar participation and oral presentation (not graded)	6 C
Examination requirements: The students should have the ability to assess coherence and facts of statements from the field of neurobiology; they should be able to answer questions on the structure and function of neurons and neuronal circuits. Furthermore they should be able to describe and compare neuronal basics of behavioral control, their experience-dependent modification and conceptual mechanisms of complex behavior; they should be able to describe and compare physiological mechanisms of sensory perception and different sensory modalities; they should be able to describe physiological and cellular mechanisms of aging and of neurodegenerative diseases.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in Biology
Language: English	**Person responsible for module:** Prof. Dr. Andre Fiala
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	4 - 6
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module SK.Bio.7002: Basic virology**	3 C 2 WLH
Learning outcome, core skills: The students will become familiar with the architecture of viruses and will learn how these agents replicate and evade the immune response of the host. Moreover, it will be discussed how viruses cause disease and how this process can be prevented by antivirals and vaccines. The lectures will focus on important human pathogens, including HIV, influenza and herpesviruses. Upon successful completion of the module, the students will be able to classify viruses and will have an understanding of central mechanisms underlying virus replication and pathogenesis and their inhibition by therapy and vaccination.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Basic Virology (Lecture)	2 WLH
Examination: Written examination (45 minutes)	3 C
Examination requirements: The students must assess whether statements regarding basic aspects of virology, including virus classification, viral replication, virus-host interactions, pathogenesis, immune evasion and antiviral therapy and vacciantion, are correct.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in Biology
Language: English	**Person responsible for module:** Prof. Dr. Stefan Pöhlmann
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 6
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module SK.Bio.7003: Isolation and characterization of fungal contaminations from food or other sources**	3 C 2 WLH

Learning outcome, core skills: The students deepen their present laboratory praxis by analyzing mold contaminations on food or other sources using recent methods of genetics and molecular cell biology. After passing the module the students can independently plan and perform experiments, document primary data, investigate the literature, and know how unknown mold fungi can be indentified.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Isolation and characterization of fungal contaminations from food or other sources (Internship)	2 WLH
Examination: Minutes / Lab report (max. 20 pages) **Examination prerequisites:** Regular participation in the practical course	3 C

Examination requirements: In the report the students should describe from which food or source they have isolated and characterized which mold fungus and which methods were used for characterization. They should describe reproducibly the experiments performed by means of performance, description of the results with illustrations and conclusion. With the help of literature research they should discuss their results. The report should be written in English.	

Admission requirements: B.Bio.129	**Recommended previous knowledge:** B.Bio.118
Language: English	**Person responsible for module:** Dr. rer. nat. Britta Herzog
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 5 - 6
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module SK.Bio.7004: Environmental microbiology**	3 C 2 WLH

Learning outcome, core skills: The students will acquire a comprehensive understanding of basic microbial processes in the environment. Students will learn how microorganisms are effective in biogeochemical cycles and how these cycles evolved in Earth's history and shaped our biosphere. They will gain knowledge about important microbial habitats (terrestrial/aquatic/extreme), and their microbial diversity. They will be introduced in the application of microorganisms in bioremediation and environmental biotechnology.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Environmental microbiology (Lecture)	2 WLH
Examination: Oral Presentation (approx. 5 minutes)	3 C

Examination requirements: Revising a specific topic in environmental microbiology, compilation of data and preparation/short presentation of a scientific poster.	

Admission requirements: B.Bio.118	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Rolf Daniel PD Dr. Michael Hoppert
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 5 - 6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module SK.Bio.7005: Methods for the identification of protein-protein interactions**	3 C 2 WLH
Learning outcome, core skills: The students obtain basic knowledge of the identification of protein-protein interactions. In small groups and in different departments of the Institute of Microbiology and Genetics, they learn the application of selected methods that they present to their fellow students in a concluding seminar at the end of the course. Through the successful participation in the course the students get an overview on different methods for the identification of protein-protein interactions and improve their English communication skills in the lab and in seminars.	**Workload:** Attendance time: 28 h Self-study time: 62 h
Course: Practical course in the participating groups of the Institute of Microbiology and Genetics	2 WLH
Examination: Oral Presentation (approx. 15 minutes) **Examination prerequisites:** Regular participation in the practical course	3 C
Examination requirements: The students should present and discuss the applied method for the identification of protein-protein interactions (e.g. immunoprecipitation, affinity chromatography, bimolecular fluorescence complementation, immunoelectron microscopy) in English.	

Admission requirements: Successful participation in one of the following biological basic modules: B.Bio.129 Genetics and microbial cell biology B.Bio.118 Microbiology B.Bio.112 Biochemistry	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. Oliver Valerius
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 5 - 6
Maximum number of students: 12	

Georg-August-Universität Göttingen **Module SK.Bio.7007: Methods in molecular virology**	3 C 2 WLH

Learning outcome, core skills: The students are introduced to the repertoire of methods used in virological research and diagnostics. The course focuses on current developments and seminal experiments from the past. The students will train their ability to extract scientific methods from the literature by themselves and to devise their own strategies to tackle a scientific problem. Each seminar unit the students have the opportunity to develop their own strategies to solve a specific problem and to discuss their strategies with their fellow students. The students are encouraged to come up with as many alternative approaches as possible. The students' solutions are then compared to published techniques, which are presented in the form of a short talk by a student or the teacher.	**Workload:** Attendance time: 28 h Self-study time: 62 h

Course: Methods in molecular virology (Seminar)	2 WLH

Examination: Lecture (approx. 30 minutes), not graded **Examination prerequisites:** Regular participation in the seminar	3 C

Examination requirements: Understanding and scientific presentation of methods in molecular virology in a seminar talk (approx. 20 minutes) with subsequent discussion (approx. 10 minutes).	

Admission requirements: none	**Recommended previous knowledge:** basic knowledge in virology (e.g. SK.Bio.7002), basic knowledge in molecular biology
Language: English	**Person responsible for module:** Dr. Alexander Hahn
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4 - 6
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module SK.EP.E10M: Intercultural Skills: Studying abroad**	6 C 2 WLH

Learning outcome, core skills: • students acquire basic intercultural competences as to the country of their target language (e.g. manners, way of life) • students acquire advanced language practice competences in their target language • students enhance their social and self-competences • students enhance their subject-specific competences by studying in an English-speaking country	**Workload:** Attendance time: 28 h Self-study time: 152 h

Courses: **1. Stay Abroad** **2. Training/Evaluating Seminars accomplishing the Stay Abroad**	 2 WLH
Examination: Term Paper (max. 3000 words), not graded **Examination prerequisites:** Regular active participation, not more than two absences with valid excuses.	6 C

Examination requirements: Students have to prove their intercultural competences as well as their ability to reflect upon them.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Carola Surkamp
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen Module SK.EP.E11M: Intercultural Skills: Teaching abroad	6 C 2 WLH
Learning outcome, core skills: • students acquire basic intercultural competences as to the country of their target language (e.g. manners, way of life) • students acquire advanced language practice competences in their target language • students enhance their social and self-competences • students enhance their subject-specific and didactic competences by transfer to a school in an English-speaking country; they acquire new didactic concepts by working as an assistant teacher (min. 3 months)	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Training/Evaluating Seminars accomplishing the Stay Abroad** **2. Stay Abroad**	 2 WLH
Examination: Term Paper (max. 3000 words), not graded **Examination prerequisites:** Regular active participation, not more than two absences with valid excuses.	6 C
Examination requirements: Students have to prove their intercultural competences as well as their ability to reflect upon them.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Carola Surkamp
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module SK.EP.E12M: Intercultural Skills: Internship abroad**	6 C 2 WLH
Learning outcome, core skills: • students acquire basic intercultural competences as to the country of their target language (e.g. manners, way of life) • students acquire advanced language practice competences in their target language • students enhance their social and self-competences • students acquire basic or enhanced professional competences by completing an internship in an English-speaking country (min. 3 months)	**Workload:** Attendance time: 28 h Self-study time: 152 h
Courses: **1. Stay Abroad** **2. Training/Evaluating Seminars accomplishing the Stay Abroad**	 2 WLH
Examination: Term Paper (max. 3000 words), not graded **Examination prerequisites:** Regular active participation, not more than two absences with valid excuses.	6 C
Examination requirements: Students have to prove their intercultural competences as well as their ability to reflect upon them.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Carola Surkamp
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module SK.EP.E3: Basic Planning Skills**	4 C 2 WLH
Learning outcome, core skills: After successful completion, students will be able to • prepare contents for a learning group, under an instructor's supervision • plan a teaching unit • use varying didactic approaches in order to impart subject-specific contents	**Workload:** Attendance time: 28 h Self-study time: 92 h
Course: See relevant class announcements	2 WLH
Examination: Draft on planning and procedure (max. 3500 Words), not graded **Examination prerequisites:** Regular active participation, not more than two absences with valid excuses.	
Examination requirements: Students show that • they can structure a teaching unit chronologically • they are familiar with varying didactic approaches, and • that they can reflect on their possible uses with regard to these uses' subject-specific fields	

Admission requirements: Für dieses Modul sollte mindestens ein Aufbaumodul im entsprechenden Teilbereich (Literatur-/Sprachwissenschaft) bereits erfolgreich abgeschlossen sein. Dieses Modul ist für Fortgeschrittene.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Frauke Reitemeier
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 5
Maximum number of students: 8	

Georg-August-Universität Göttingen **Module SK.IKG-ISZ.40: Academic Writing in Multilingual Contexts (MultiConText)**	6 C 2 WLH
Learning outcome, core skills: In this module students of all disciplines learn about strategies for academic writing and academic practice in multilingual contexts and how to apply them successfully on their own working processes. The focus lies on empowering students to use their own multilingualism in their academic pratice and their writing process and to think these processes across and beyond languages. Besides the linguistic aspects in academic texts, in this module we will have a close look on the individual academic imprint and how it can be integrated into one's own academic writing and practice. The theoretical background for this module are concepts of multilingualism and translingualism. The students learn the constructive and purposeful use of their linguistic resources to develop their own academic style. Work with the student's own academic texts during the workshop is structured integratively. The writing process and the academic practice – in which the development of academic writing is embeded – will be interactively reflected on the levels of peerfeedback, the framework of requirements at a german university and feedback of the module lecturer(s). Thereby, students learn about different areas of feedback for their academic work and the constructive use of it for the revision of multilingual academic texts.	**Workload:** Attendance time: 28 h Self-study time: 152 h
Course: Academic writing and academic practice in multilingual contexts (Block course) *Contents*: *Students from different backgrounds and disciplines learn how to consciously apply their multilingual strategies and resources acquired in their international academic contexts. In this workshop, they will be offered the possibility to work with texts and to develop their own writing style influenced by the languages, backgrounds and academic contexts they have visited or come from.* *The students are invited to bring different texts they work with and texts they wrote during their academic development. These texts can of course be in different languages. The texts will be analyzed and discussed during the workshop with a focus beyond languages and rather on structure, formation and author reference. Students will apply this knowledge of their multilingual resources and strategies on the development of their own academic writing skills.*	
Examination: Learning journal (max. 20 pages) **Examination prerequisites:** Written tasks (max. 20 p.), regelmäßige Teilnahme **Examination requirements:** Competences in multi- and translingual academic writing and academic practice and their application on the development of the personal academic style	6 C

Admission requirements:	**Recommended previous knowledge:**

Language proficiency of English and/or German at least C1 CEFR	first experiences in academic writing
Language: English, German	**Person responsible for module:** Irina Barczaitis
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: 12	

Additional notes and regulations: This module is recommended to students in international study programs. Dieses Modul wird für Studierende in international orientierten Studiengängen empfohlen.

Georg-August-Universität Göttingen **Module SK.IKG-ISZ.42: Texte verstehen und produzieren in mehrsprachigen Kontexten (MultiConText)**	3 C 1 WLH
Learning outcome, core skills: In this module, students get to know the different phases and steps of academic writing and working with their specific requirements. These phases and steps, e.g. the reading and processing of unfamiliar texts or the structuring of personal texts, will be practiced and reflected on with the support of writing exercises. An important aspect of this module is the accomplishment of the phases and steps necessary for academic writing in a multilingual context. It focuses on supporting students in using different languages productively in their writing and thinking -process. The **students choose 3 out of 6 workshops** on different topics of multilingual academic writing, which suit their actual working requirements best. To **accomplish the module**, students will have to **hand in the portfolio tasks required for the three workshops chosen**.	**Workload:** Attendance time: 14 h Self-study time: 76 h
Courses: **1. Workshop: Writing Abstracts/ Abstracts schreiben** (Block course) **2. Workshop: Academic Style/ Wissenschaftlicher Stil** (Block course) **3. Workshop: Paraphrasing and Referencing/ Paraphrasieren und Belegen** (Block course) **4. Workshop: Reading and summarizing texts/ Wissenschaftliche Texte lesen und zusammenfassen** (Block course) **5. Workshop: Structuring texts/ Texte strukturieren** (Block course) **6. Workshop: Taking Notes/ Mitschreiben** (Block course)	
Examination: Portfolio (max. 20 pages) **Examination prerequisites:** Written tasks (max. 15 pages), regular attendance **Examination requirements:** Knowledge and reflection of the different phases and steps of academic writing, knowledge of strategies for the accomplishment of the workprocess during academic writing, competences in the use of multilingual writing	3 C

Admission requirements: Language proficiency of English and/or German at least C1 CEFR	**Recommended previous knowledge:** -
Language: English, German	**Person responsible for module:** Ella Grieshammer
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	from 2
Maximum number of students: 15	

Additional notes and regulations:

The **students choose 3 out of 6 workshops** on different topics of multilingual academic writing, which suit their actual working requirements best. To **accomplish the module**, students will have to **hand in the portfolio tasks required for the three workshops chosen.**

This module is recommended to students in international study programs.

Dieses Modul wird für Studierende in international orientierten Studiengängen empfohlen.

Georg-August-Universität Göttingen Module SK.IKG-ISZ.43: Mehrsprachig Präsentationen vorbereiten und halten (MultiConText)	4 C 1 WLH

Learning outcome, core skills: The aim of this module is to support students in the competent use of their multilingualism as a resource to prepare an oral presentation. Theoretical aspects concerning concepts of multilingual academic practice, the planning of a presentation and different forms of written based orality as well as expectations towards presenting the academic context of a German university will be considered. Along with these considerations, students will work on practical exercises to gain more experience in the different parts of the process of preparing presentations, using their multilingual backgrounds as a resource and extending their presentation skills.	**Workload:** Attendance time: 14 h Self-study time: 106 h
Course: Preparing Presentations Across Languages / Mehrsprachig Präsentationen vorbereiten und halten (Block course) *Contents*: This workshop offers students of all faculties in international study programs the possibility to train their presentation and rhetorical skills in written based orality. Starting from students' experience in presenting the workshop focuses on developing and extending their knowledge regarding presenting in academic contexts at a German university. Along with some theoretical concepts of how to schedule an oral presentation, exercises involving students' own presentations' preparation constitute a main part of the workshop. As oral presenting also involves writing activities such as handouts, presentation cards and slides, it is therefore relevant to combine oral and written competencies. Students will apply the acquired knowledge in a short presentation which will be delivered and feedbacked during the workshop.	
Examination: Portfolio (max. 20 pages) **Examination prerequisites:** written tasks (max. 15 pages); presentation (ca. 15 minutes), regular attendance **Examination requirements:** Competences in the field of written orality, use of the own multilingualism as a resource for preparing presentations, competences in academic rhetoric, provision of functional presentation media for the academic sphere, competences to reflect presentations delivered in the academic field.	4 C

Admission requirements: Language proficiency of English and/or German at least C1 CEFR	**Recommended previous knowledge:** none
Language: English, German	**Person responsible for module:** Irina Barczaitis
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

twice	from 1
Maximum number of students: 12	

Additional notes and regulations:

This module is recommended to students in international study programs.

Dieses Modul wird für Studierende in international orientierten Studiengängen empfohlen.

Georg-August-Universität Göttingen **Module SK.IKG-ISZ.44: Fachliteratur in mehreren Sprachen lesen und im eigenen akademischen Text nutzen (MultiConText)**	3 C 1 WLH
Learning outcome, core skills: Reading scientific literature and handling it in the own academic text is an important part of academic writing. Many students use scientific literature in several languages for their academic texts. This module focuses on reading and handling literature in several languages for the process of academic writing. Students learn how to use different reading strategies for different reading purposes, how to process literature in several languages efficiently and how to implement it into their own acadmic texts in an adequate and functional way.	**Workload:** Attendance time: 14 h Self-study time: 76 h
Course: Workshop: Reading and handling scientific literature in several languages for the own academic text (Block course)	
Examination: Learning journal (max. 20 pages) **Examination prerequisites:** Written tasks (max. 15 p.), regular attendance **Examination requirements:** Competent use of different reading strategies, knowledge about the efficient use of transfer-texts for writing academic texts, competencies in implementing scientific literature into the own academic texts	3 C

Admission requirements: Language proficiency of English and/or German at least C1 CEFR	**Recommended previous knowledge:** -
Language: English, German	**Person responsible for module:** Irina Barczaitis
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 1
Maximum number of students: 15	

Additional notes and regulations: This module is recommended to students in international study programs. Dieses Modul wird für Studierende in international orientierten Studiengängen empfohlen.