Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Subdivided Module Catalogue

for the Subject

Mathematics

as a Master's with 1 major

with the degree "Master of Science"

(120 ECTS credits)

Examination regulations version: 2010
Responsible: Institute of Mathematics

Course of Studies - Contents and Objectives

The mathematics Master programme is offered by the Department of Mathematics, with a total of currently (SS 2010) 9 chairs.

The Masters study programme in mathematics is intended to provide the students with the following abilities.

- capacity of abstraction,
- exactness in analytic reasoning,
- excellent capacity to realize the structure of complex interconnections,
- sound qualification in applying mathematical methods to specific problems,
- insight into the intrinsic mathematical interdependence of different mathematical fields, as well as into interdisciplinary connections,
- high stamina in dealing with difficult problems,
- high competence in problem solving,
- ability to carry our independent scientific work on a high level,
- ability to cooperate as responsible mathematician within an interdisciplinary team of mathematicians, computer scientists, natural scientists, engineers, or specialists in economical sciences and entrepreneurship,
- insight into and overview over current research in at least one field of contemporary mathematics,
- qualification for meeting the standards of a Ph.D. study in mathematics (if applicable).

For the Master thesis the student should work on a thematic and temporally closely limited frame in order to carry out independently a mathematical task, using well-known procedures and scientific criteria, or modifying them if necessary.

The Masters exam should ascertain whether the candidate overlooks the context of the basics in mathematics and possesses the ability to use the corresponding scientific methods, achieving in this way a further professional and/or scientific qualification.

Abbreviations used

Course types: **E** = field trip, **K** = colloquium, **O** = conversatorium, **P** = placement/lab course, **R** = project, **S** = seminar, **T** = tutorial, **Ü** = exercise, **V** = lecture

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

Methods of grading: **NUM** = numerical grade, **B/NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

ASPO2009

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

05-Jul-2010 (2010-35)

14-Jul-2011 (2011-69)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

The subject is divided into

Abbreviation	Module title	ECTS credits	Method of grading	page
Mathematics				
Advanced Programme (15 ECTS credits)				
10-M=ARTH-102-m01	Introduction to Control Theory	10	NUM	74
10-M=AAAN-102-m01	Applied Analysis	10	NUM	54
10-M=AALG-102-m01	Topics in Algebra	10	NUM	56
10-M=ADGM-102-m01	Differential Geometry	10	NUM	58
10-M=AFTH-102-m01	Complex Analysis	10	NUM	60
10-M=AGMS-102-m01	Geometric Structures	10	NUM	62
10-M=AIST-102-m01	Industrial Statistics 1	10	NUM	66
10-M=ALTH-102-m01	Lie Theory	10	NUM	68
10-M=ANGG-102-m01	Numeric of large Systems of Equations	10	NUM	70
10-M=AOPT-102-m01	Basics of Optimization	10	NUM	72
10-M=ASMR-102-m01	Stochastic Models for Risk Analysis	10	NUM	76
10-M=ASTP-102-m01	Stochastical Processes	10	NUM	78
10-M=ATOP-102-m01	Topology	10	NUM	80
10-M=AVSM-102-m01	Insurance Mathematics	10	NUM	82
10-M=AZRA-102-m01	Time Series Analysis 1	10	NUM	84
10-M=AZTH-102-m01	Number Theory	10	NUM	86
10-M=AGPC-102-m01	Giovanni-Prodi Lecture (Master)	5	NUM	64
Specialisation (15 ECTS credits)				
10-M=VATP-102-m01	Algebraic Topology	10	NUM	115
10-M=VFNM-102-m01	Special Topics in Financial Mathematics	10	NUM	121
10-M=VGDS-102-m01	Groups and their Representations	10	NUM	123
10-M=VGEM-102-m01	Geometrical Mechanics	10	NUM	125
10-M=VIST-102-m01	Industrial Statistics 2	10	NUM	131
10-M=VKAR-102-m01	Field Arithmetics	10	NUM	133
10-M=VNPE-102-m01	Numeric of Partial Differential Equations	10	NUM	143
10-M=VOPT-102-m01	Selected Topics in Optimization	10	NUM	145
10-M=VSTA-102-m01	Statistical Analysis	10	NUM	151
10-M=VVSM-102-m01	Insurance Mathematics 2	10	NUM	153
10-M=VZRA-102-m01	Time Series Analysis 2	10	NUM	157
10-M=VDIM-102-m01	Discrete Mathematic	5	NUM	117
10-M=VDSR-102-m01	Dynamical Systems and Control	5	NUM	119
10-M=VGEO-102-m01	Aspects of Geometry	5	NUM	127
10-M=VGRM-102-m01	Basics in Mathematics	5	NUM	129
10-M=VMBV-102-m01	Mathematical Imaging	5	NUM	135
10-M=VMPH-102-m01	Selected Topics in Mathematical Physics	5	NUM	137
10-M=VMTH-102-m01	Modul Theory	5	NUM	139
10-M=VNAN-102-m01	Non-Linear Analysis	5	NUM	141
10-M=VOST-102-m01	Optimal Control	5	NUM	147
10-M=VQKC-102-m01	Quantum Control and Quantum Computing	5	NUM	149
10-M=VVSY-102-m01	Networked Systems	5	NUM	155

Workshops and Seminars (10 ECTS credits)				
10-M=GALG-102-m01	Study Group Algebra	10	NUM	91
10-M=GDIM-102-m01	Study Group Discrete Mathematics	10	NUM	92
10-M=GDSR-102-m01	Study Group Dynamical Systems and Control	10	NUM	93
10-M=GFTH-102-m01	Study Group Complex Analysis	10	NUM	94
10-M=GGMT-102-m01	Study Group Geometry and Topology	10	NUM	95
10-M=GMKX-102-m01	Study Group Mathematics in its Context	10	NUM	96
10-M=GMUI-102-m01	Study Group Measure and Integral	10	NUM	97
10-M=GNMA-102-m01	Study Group Numerical Mathematics and Applied Analysis	10	NUM	98
10-M=GROK-102-m01	Study Group Robotic, Optimization and Control Theory	10	NUM	99
10-M=GSTA-102-m01	Study Group Statistics	10	NUM	100
10-M=GZRA-102-m01	Study Group Time Series Analysis	10	NUM	101
10-M=GZTH-102-m01	Study Group Number Theory	10	NUM	102
10-M=SADG-102-m01	Seminar in Applied Differential Geometry	5	NUM	104
10-M=SALG-102-m01	Seminar in Algebra	5	NUM	105
10-M=SDSR-102-m01	Seminar in Dynamical Systems and Control	5	NUM	106
10-M=SFTH-102-m01	Seminar in Complex Analysis	5	NUM	107
10-M=SFVM-102-m01	Seminar Financial and Insurance Mathematics	5	NUM	108
10-M=SGMT-102-m01	Seminar in Geometry and Topology	5	NUM	109
10-M=SGPC-102-m01	Giovanni-Prodi Seminar (Master)	5	NUM	110
10-M=SIDZ-102-m01	Interdisciplinary Seminar	5	NUM	111
10-M=SNMA-102-m01	Seminar in Numerical Mathematics and Applied Analysis	5	NUM	112
10-M=SOPT-102-m01	Seminar in Optimization	5	NUM	113
10-M=SSTA-102-m01	Seminar in Statistics	5	NUM	114
Learning by Teaching No more than 10 ECTS credits; students may choose whether or not to take modules in this area.				
10-M=ELT1-102-m01	Learning by teaching Mathematics 1	5	NUM	88
10-M=ELT2-102-m01	Learning by Teaching 2	5	NUM	89
Thesis (30 ECTS credits)				
10-M=MAAR-102-m01	Master Thesis Mathematics	30	NUM	103
Optional Application-oriented Subject and/or Application-oriented Work Placement Students may choose whether or not to take modules in this area. Students may choose to complete modules from the specified application-oriented subjects and/or an application-oriented work placement worth a total of no more than 30 ECTS credits.				
Application-oriented Subject Chemistry				
08-TCM2-102-m01	Computational Chemistry	5	NUM	12
08-TCM1-102-m01	Theoretical Chemistry	5	NUM	11
08-MCM3-102-m01	Principles of drug design	5	NUM	8
08-TCM3-102-m01	Programming in Theoretical Chemistry	5	NUM	13
08-TCAP-102-m01	Theoretical Chemistry - Project work	10	B/NB	9
Application-oriented Subject Computer Science				
10-I-GT-102-m01	Algorithmic Graph Theory	5	NUM	46
10-I-DB-102-m01	Databases	5	NUM	43
10-I-WBS-102-m01	Knowledge-based Systems	5	NUM	53
10-I-DM-102-m01	Data Mining	5	NUM	45
10-I-KT-102-m01	Theory of Complexity	5	NUM	47
10-I-AR-102-m01	Automation and Control Technology	8	NUM	41

10-I=DK-102-m01	Data Compression	8	NUM	23
10-I=PVS-102-m01	Programming of Distributed Systems	8	NUM	33
10-I=IR-102-m01	Information Retrieval	5	NUM	26
10-I=KI-102-m01	Artificial Intelligence	8	NUM	28
10-I=EL-102-m01	E-Learning	5	NUM	24
10-I=MI-102-m01	Medical Informatics	5	NUM	31
10-I=DDB-102-m01	Deductive Databases	8	NUM	22
10-I=DB2-102-m01	Databases II	5	NUM	21
10-I=LVS-102-m01	Analytical Performance Evaluation of Distributed Systems	8	NUM	30
10-I=ST-102-m01	Simulation Techniques for Performance Evaluation	8	NUM	39
10-I=AFS-102-m01	Automata Theory and Formal Languages	8	NUM	15
10-I=BL-102-m01	Computability Theory and Mathematical Logic	8	NUM	19
10-I=KT2-102-m01	Advanced Topics in Computational Complexity	8	NUM	29
10-I=KD-102-m01	Cryptography and Data Security	5	NUM	27
10-I=AG-102-m01	Computational Geometry	5	NUM	16
10-I=APA-102-m01	Approximation Algorithms	5	NUM	18
10-I=VG-102-m01	Visualization of Graphs	5	NUM	40
10-I=AGIS-102-m01	Algorithms for Geographic Information Systems	5	NUM	17
10-I=CB-102-m01	Compiler Construction	8	NUM	20
10-I=PA-102-m01	Program Design and Analysis	5	NUM	32
10-I=RAM-102-m01	Computer Arithmetic	5	NUM	34
Application-oriented Subject Aerospace Computer Science				
10-I-AR-102-m01	Automation and Control Technology	8	NUM	41
10-I-RAK-102-m01	Computer Architecture	5	NUM	49
10-I-RK-102-m01	Computer Networks and Communication Systems	8	NUM	51
10-I=ES-102-m01	Embedded Systems	8	NUM	25
10-I=RO-102-m01	Robotics	8	NUM	35
10-I=SSD-102-m01	Spacecraft Systems Design	8	NUM	38
10-I=AA-102-m01	Advanced Automation	8	NUM	14
10-I=RO2-102-m01	Robotics II: Networked Robots	8	NUM	37
Application-oriented Subject Physics				
11-ASL-092-m01	Applied Superconduction	6	NUM	165
11-EPP-092-m01	Introduction to Plasmaphysics	6	NUM	171
11-AHL-092-m01	Applied Semiconductor Physics	6	NUM	159
11-FK2-092-m01	Solid State Physics 2	8	NUM	173
11-FKS-092-m01	Solid State Spectroscopy	6	NUM	175
11-FKT-092-m01	Transport Phenomena in Solids	6	NUM	177
11-HNS-092-m01	Semiconductor Nanostructures	6	NUM	181
11-MAG-092-m01	Magnetism	6	NUM	183
11-NDS-092-m01	Low-Dimensional Structures	4	NUM	185
11-NOP-092-m01	Nano-Optics	4	NUM	189
11-QM2-092-m01	Quantum Mechanics II	8	NUM	193
11-QPM-092-m01	Quantum Phenomena in electronic correlated Materials	6	NUM	195
11-QVTP-092-m01	Many Body Quantum Theory	8	NUM	197
11-RMS-092-m01	Relativistic Effects in Mesoscopic Systems	5	NUM	199
11-TFK-092-m01	Theoretical Solid State Physics	8	NUM	213

11-TSL-092-m01	Theory of Superconduction	5	NUM	219
11-PKS-092-m01	Physics of Complex Systems	6	NUM	191
11-SDC-092-m01	Statistics, Data Analysis and Computer Physics	4	NUM	207
11-AKM-092-m01	Cosmology	6	NUM	161
11-APL-092-m01	Plasma-Astrophysics	6	NUM	163
11-ASP-092-m01	Introduction to Space Physics	6	NUM	167
11-AWP-092-m01	Atmosphere and Space Physics	6	NUM	169
11-GRT-092-m01	Group Theory	6	NUM	179
11-NMA-092-m01	Numerical Methods in Astrophysics	6	NUM	187
11-RNT-092-m01	Renormalization Theory	6	NUM	201
11-RQFT-092-m01	Relativistical Quantumfield Theory	8	NUM	203
11-RTT-092-m01	Theory of Relativity	6	NUM	205
11-TEP-092-m01	Theoretical Elementary Particle Physics	8	NUM	211
11-TPE-092-m01	Experimental Particle Physics	4	NUM	215
11-TPS-092-m01	Particle Physics (Standard Model)	8	NUM	217
11-SUS-092-m01	Supersymmetry I and II	6	NUM	209
Application-oriented Work Placement (10 ECTS credits)				
10-M=EPRK-102-m01	Internship (Lab Course) Applied Mathematics	10	NUM	90

Module title			Abbreviation
Principles of drug design			08-MCM3-102-m01
Module coordinator		**Module offered by**	
lecturers Pharmazeutische Chemie (Pharmaceutical Chemistry)		Institute of Pharmacy and Food Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Fundamentals: drug targets (types and classification), target validation, effect mechanisms, protein-ligand interactions, lead finding; lead optimisation. Experimental methods: bioassays, HTS, combinatorial chemistry, naturally occurring substances. Theoretical methods: molecular modelling, structure-based drug design, pharmacophore models, docking, virtual screening, simulation methods, de novo design. Ligand-based drug design. QSAR. Predictions of pharmacokinetic and toxicological components (ADME). Case examples, prodrug strategies, bioisosterism, SAR.

Intended learning outcomes

Students master the theoretical and experimental methods and aspects of drug design.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

presentation with discussion (approx. 30 minutes)
Language of assessment: German or English

Allocation of places

Chemistry Master's and Mathematics Master's: no restrictions. Biochemistry Master's: 10 places. Places will be allocated by lot.

Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Biochemistry (2012)
Master's degree (1 major) Chemistry (2010)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) FOKUS Pharmacy (2012)

Module title			Abbreviation
Theoretical Chemistry - Project work			08-TCAP-102-m01
Module coordinator		**Module offered by**	
head of the research group offering the module		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to get involved in the work of one of the research groups based at the Institute of Theoretical Chemistry and learn some of the methods typically used in the discipline.

Intended learning outcomes

Students have learned some of the methods typically used in theoretical chemistry. They are able to explain issues that are relevant to the fields covered.

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

This module has 3 components; information on courses listed separately for each component.

- 08-TCAP-1-102: P (no information on language and number of weekly contact hours available)
- 08-TCAP-2-102: P (no information on language and number of weekly contact hours available)
- 08-TCAP-3-102: P (no information on language and number of weekly contact hours available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

This module has the following 3 assessment components. To pass the module as a whole students must pass two out of these three assessment components.

Assessment component to module component 08-TCAP-1-102: Theoretische Chemie Arbeitsgruppenpraktikum Wellenpaketdynamik

- 5 ECTS credits, method of grading: (not) successfully completed
- presentation (approx. 30 minutes)
- Language of assessment: German or English

Assessment component to module component 08-TCAP-2-102: Theoretische Chemie Arbeitsgruppenpraktikum Wellenfunktionsmethoden

- 5 ECTS credits, method of grading: (not) successfully completed
- presentation (approx. 30 minutes)
- Language of assessment: German or English

Assessment component to module component 08-TCAP-3-102: Theoretische Chemie Arbeitsgruppenpraktikum Dichtefunktionaltheorie

- 5 ECTS credits, method of grading: (not) successfully completed
- presentation (approx. 30 minutes)
- Language of assessment: German or English

Allocation of places

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Additional information

Additional information on module duration: 4 weeks..

Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Chemistry (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Theoretical Chemistry			08-TCM1-102-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Theoretische Chemie"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).	

Contents

This module introduces students to the fundamental principles of theoretical chemistry.

Intended learning outcomes

Students are able to describe the mathematical and physical principles underlying the quantum chemical and quantum dynamical approaches of theoretical chemistry.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (90 minutes)
Language of assessment: German or English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
Master's degree (1 major) FOKUS Pharmacy (2012)

Module title			Abbreviation
Computational Chemistry			08-TCM2-102-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Computational Chemistry"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).	

Contents

This module introduces students to the fundamental principles of computational chemistry.

Intended learning outcomes

Students are able to explain the theoretical principles of computational chemistry and to apply methods in computational chemistry.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (90 minutes)
Language of assessment: German or English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Programming in Theoretical Chemistry			08-TCM3-102-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Programmieren in Theoretischer Chemie"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module provides an introduction to the fundamentals of programming in theoretical chemistry and discusses its application areas.

Intended learning outcomes

Students are able to explain and use one of the programming languages typically used in theoretical chemistry as well as to name its application areas.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

completion and discussion of approx. 5 programming exercises as well as talk (approx. 45 minutes)
Language of assessment: German or English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2013)
Master's degree (1 major) Chemistry (2010)
Master's degree (1 major) Chemistry (2014)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Advanced Automation			10-I=AA-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Advanced topics in automation systems as well as instrumentation and control engineering, for example from the field of sensor data processing, actuators, cooperating systems, mission and trajectory planning.

Intended learning outcomes

The students have an advanced knowledge of selected topics in automation systems. They are able to implement advanced automation systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Automata Theory and Formal Languages			10-I=AFS-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IV		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Chomsky's theories of grammar and language classes, grammar normal forms, finite automata, pushdown automata, linear bound automaton, closure properties of language classes, decidability questions, minimisation of finite automata, regular sets, star-free languages, language acceptance by monoids, logic description of regular languages.

Intended learning outcomes

The students have a fundamental and applicable knowledge in the areas of Chomsky's grammar and language classes, of grammar normal forms, finite automata, push-down automata, linear bound automata, closure properties of language classes, decidability questions, minimising of finite automata, regular sets, star-free languages, language acceptance by monoids and logic descriptions of regular languages.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Computational Geometry			10-I=AG-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

In many areas of computer science -- for example robotics, computer graphics, virtual reality and geographic information systems -- it is necessary to store, analyse, create or manipulate spatial data. This class is about the algorithmic aspects of these tasks: We will acquire techniques that are needed to plan and analyse geometric algorithms and data structures. Every technique will be illustrated with a problem in the practical areas listed above.

Intended learning outcomes

The students are able to decide which algorithms or data structures are suitable for the solution of a given geometric problem. The students are able to analyse new problems and to come up with their own efficient solutions based on the concepts and techniques acquired in the lecture.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Algorithms for Geographic Information Systems			10-I=AGIS-102-m01
Module coordinator			**Module offered by**
holder of the Chair of Computer Science I			Institute of Computer Science
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Algorithmic foundations of geographic information systems and their application in selected problems of acquisition, processing, analysis and presentation of spatial information. Processes of discrete and continuous optimisation. Applications such as the creation of digital height models, working with GPS trajectories, tasks of spatial planning as well as cartographic generalisation.

Intended learning outcomes

The students are able to formalise algorithmic problems in the field of geographic information systems as well as to select and improve suitable approaches to solving these problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Approximation Algorithms			10-I=APA-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

The task of finding the optimal solution for a given problem is omnipresent in computer science. Unfortunately, there are many problems without an efficient algorithm for an optimal solution. As a result, in practice, methods are used which do not always give the optimal solution but always give good solutions. This lecture will discuss drafting and analysing techniques for algorithms which have a proven approximation quality. With the help of practical optimisation problems, the lecture will introduce students to important drafting techniques such as greedy, local search, scaling as well as methods based on linear programming.

Intended learning outcomes

The students are able to analyse easy approximation methods in terms of their quality. They understand fundamental drafting techniques such as greedy, local search and scaling as well as methods based on linear programming and are able to apply these to new problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Computability Theory and Mathematical Logic			10-I=BL-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IV		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Gödel numbering, decidable and countable sets, halting problem, m-reducibility and completeness, create and productive sets, relative computability, Turing reduction, countable degrees, theorem by Friedberg and Muchnik, arithmetic hierarchy, propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of Gödel numbering, decidable and countable sets, halting problem, m-reducibility and completeness, creative and productive sets, relative computability, Turing reducibility, countable degrees, theorem by Friedberg and Muchnik, arithmetic hierarchy, propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Compiler Construction			10-I=CB-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science II		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Lexical analysis, syntactic analysis, semantics, compiler generators, code generators, code optimisation.

Intended learning outcomes

The students possess knowledge in the formal description of programming languages and their compilation. They are able to perform transformations between them with the help of finite automata, push-down automata and compiler generators.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Databases II			10-I=DB2-102-m01
Module coordinator			**Module offered by**
Dean of Studies Informatik (Computer Science)			Institute of Computer Science
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Data warehouses and data mining; XML databases; web databases;introduction to Datalog.

Intended learning outcomes

The students have advanced knowledge about relational databases, XML and data mining.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Business Information Systems (2011)
Master's degree (1 major) Business Information Systems (2013)
Master's degree (1 major) Computational Mathematics (2012)
Master's degree (1 major) Functional Materials (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Deductive Databases			10-I=DDB-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Syntax and semantics of logic programs; data structures, program structures and applications for Prolog; analytical methods for Datalog; negation and stratification; disjunctive logic programs.

Intended learning outcomes

The students possess expertise in working with Prolog and Datalog (including negation and disjunction).

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Data Compression			10-I=DK-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science II		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Entropy coding, text compression, dictionary methods, block transformations, image compression, human visual system, bitplane techniques, predicative methods, hierarchical transformations, discrete cosine transform, wavelets, JPEG baseline, JPEG 200, subband coding, fractal compression, vector quantisation, video compression, MPEG standards, audio compression.

Intended learning outcomes

The students possess the methodic knowledge and practical skills for the development and use of compression methods for text, image, video and audio data.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
E-Learning			10-I=EL-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Learning paradigms, learning system types, author systems, learning platforms, standards for learning systems, intelligent tutoring systems, student models, didactics, problem-oriented learning and case-based training systems, adaptive tutoring systems, computer-supported cooperative learning, evaluation of learning systems.

Intended learning outcomes

The students possess a theoretical and practical knowledge about eLearning and are able to assess possible applications.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Business Information Systems (2011)
Master's degree (1 major) Business Information Systems (2013)
Master's degree (1 major) Computational Mathematics (2012)
Master's degree (1 major) Functional Materials (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Embedded Systems			10-I=ES-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Models of embedded systems, implementation methods (ASIC, AISIP, micro controller), verification of embedded systems, implementation planning static, periodic and dynamic, binding problems, hardware synthesis, software synthesis.

Intended learning outcomes

The students are familiar with the technical possibilities for the design of embedded systems and master the most important techniques for the modelling, verification and optimisation of such systems in hardware and software.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Information Retrieval			10-I=IR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

IR models (e. g. Boolean and vector space model, evaluation), processing of text (tokenising, text properties), data structures (e. g. inverted index), query elements (e. g. query operations, relevance feedback, query languages and paradigms, structured queries), search engine (e. g. architecture, crawling, interfaces, link analysis), methods to support IR (e. g. recommendation systems, text clustering and classification, information extraction).

Intended learning outcomes

The students possess theoretical and practical knowledge in the area of information retrieval and have acquired the technical know-how to create a search engine.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Business Information Systems (2011)
Master's degree (1 major) Business Information Systems (2013)
Master's degree (1 major) Functional Materials (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Cryptography and Data Security			10-I=KD-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography systems, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response methods, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response method, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Artificial Intelligence			10-I=KI-102-m01
Module coordinator			**Module offered by**
holder of the Chair of Computer Science VI			Institute of Computer Science
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Intelligent agents, uninformed and heuristic search, constraint problem solving, search with partial information, propositional and predicate logic and inference, knowledge representation, planning, probabilistic closure and Bayesian networks, utility theory and decidability problems, learning from observations, knowledge while learning, neural networks and statistical learning methods, reinforcement learning.

Intended learning outcomes

The students possess theoretical and practical knowledge about artificial intelligence and are able to assess possibilities for its application.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Advanced Topics in Computational Complexity			10-I=KT2-102-m01
Module coordinator			**Module offered by**
Dean of Studies Informatik (Computer Science)			Institute of Computer Science
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchy, complexity of probabilistic algorithms.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchies, complexity of probabilistic algorithms.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Analytical Performance Evaluation of Distributed Systems			10-I=LVS-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science III		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Traffic theoretic models, fundamental concepts of theory of probability, transformation techniques, stochastic processes, methods for performance analysis of technical systems, queue-/traffic theory, analysis of Markov, non-Markov and time critical systems, matrix analytical method, practical examples for performance analysis of computer systems and networks: throughput and goodput analysis and other characteristics.

Intended learning outcomes

The students possess the methodic knowledge and the practical skills necessary to model technical systems by means of the theory of probability and mathematical statistics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Medical Informatics			10-I=MI-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Electronic patient folder, coding of medical data, hospital information systems, operation of computers in infirmary and functional units, medical decision making and assistance systems, statistics and data mining in medical research, case-based training systems in medical training.

Intended learning outcomes

The students possess theoretical and practical knowledge about the application of computer science methods in medicine.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Program Design and Analysis			10-I=PA-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science II		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Program analysis, model creation in software engineering, program quality, test of programs, process models.

Intended learning outcomes

The students are able to analyse programs, to use testing frameworks and metrics as well as to judge program quality.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Business Information Systems (2011)
Master's degree (1 major) Business Information Systems (2013)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Programming of Distributed Systems			10-I=PVS-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science II		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Design and development of parallely and distributedly executed programs.

Intended learning outcomes

The students possess the methodic knowledge and practical skills for the design and development of parallely and distributedly running programs.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Computer Arithmetic			10-I=RAM-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science II		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Spaces of numerical computation, raster and rounding, definition and implementation of computational arithmetic and interval calculation.

Intended learning outcomes

The students possess knowledge about the spaces of numerical computation, raster and roundings, definition and implementation of computational arithmetic and interval calculation. They master the application of algorithms.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Robotics			10-I=RO-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

History, applications and properties of robots, direct kinematics of manipulators: coordinate systems, rotations, homogenous coordinates, axis coordinates, arm equation. Inverse kinematics: solution properties, end effector configuration, numerical and analytical approaches, examples of different robots for analytical approaches. Workspace analysis and trajectory planning, dynamics of manipulators: Lagrange-Euler model, direct and inverse dynamics. Mobile robots: direct and inverse kinematics, propulsion system, tricycle, Ackermann steering, holonomes and non-holonome restrictions, kinematic classification of mobile robots, posture kinematic model. Movement control and path planning: roadmap methods, cell decomposition methods, potential field methods. Sensors: position sensors, speed sensors, distance sensors.

Intended learning outcomes

The students master the fundamentals of robot manipulators and vehicles and are, in particular, familiar with their kinematics and dynamics as well as the planning of paths and task execution.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Robotics II: Networked Robots			10-I=RO2-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Foundations of dynamic systems, controllability and observability, controller design through pole assignment: feedback and feed-forward, state observer, feedback with state observer, time discrete systems, stochastic systems: foundations of stochastics, random processes, stochastic dynamic systems, Kalman filter: derivation, initialising, application examples, problems of Kalman filters, extended Kalman filter.

Intended learning outcomes

The students master all fundamentals that are necessary to understand Kalman filters and their use in applications of robotics. The students possess a knowledge of advanced controller and observer methods and recognise the connections between the dual pairs controllability - observability as well as controller design and observer design. They also recognise the relationship between the Kalman filter as a state estimator and an observer.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Spacecraft Systems Design			10-I=SSD-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Introduction: history of space flight, system design of spacecraft. Space dynamics: two-body dynamics, Kepler orbits, disturbance forces, transfer orbits. Mission analysis: earth and sun-synchronous orbits, shadows, solar angle of incidence. Thermal control of satellites: thermal analysis, thermal design and technologies, verification of thermal designs. Telecommunication: ground contact analysis, data transmission, satellite monitoring (telemetry, telecommando). Structure and mechanisms. Energy systems: primary, secondary, management, power generation: solar cells. On-board data processing. Propulsion systems. Tests (mechanical, electrical). Operation of spacecraft. Ground segment.

Intended learning outcomes

The students master system aspects of the layouting of technical systems. Using the example of spacecraft, major subsystems and their integration into a working whole are being analysed.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Simulation Techniques for Performance Evaluation			10-I=ST-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science III		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

Introduction to simulation techniques, statistical groundwork, creation of random numbers and random variables, random sample theory and estimation techniques, statistical analysis of simulation values, inspection of measured data, planning and evaluation of simulation experiments, special random processes, possibilities and limits of model creation and simulation, advanced concepts and techniques, practical execution of simulation projects.

Intended learning outcomes

The students possess the methodic knowledge and the practical skills necessary for the stochastic simulation of (technical) systems, the evaluation of results and the correct assessment of the possibilities and limits of simulation methods.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Visualization of Graphs			10-I=VG-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).	

Contents

This course covers the most important algorithms to draw graphs. Methods from the course *Algorithmische Graphentheorie* (*Algorithmic Graph Theory*) such as divide and conquer, flow networks, integer programming and the planar separator theorem will be used. We will become familiar with measures of quality of a graph drawing as well as algorithms to optimise these measures.

Intended learning outcomes

The participants get an overview of graph visualisation and become familiar with typical tools. They consolidate their knowledge about the modelling and solving of problems with the help of graphs and graph algorithms.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Automation and Control Technology			10-I-AR-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Overview of automation systems, fundamental principles of control technology, Laplace transformation, transfer function, plant, controller types, basic feedback loop, fundamental principles of control engineering, automata, structure of Petri nets, Petri nets for automisation, machine-related structure of processing computation machines, communication between process computers and periphery devices, software for automation systems, process synchronisation, process communication, real-time operating systems, real-time planning.

Intended learning outcomes

The students master the fundamentals of automation and control.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Mathematics (2012)
Bachelor' degree (1 major) Mathematics (2013)
Bachelor' degree (1 major) Computational Mathematics (2012)
Bachelor' degree (1 major) Computational Mathematics (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Databases			10-I-DB-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Relational algebra and complex SQL statements; database planning and normal forms; transaction management.

Intended learning outcomes

The students possess knowledge about database modelling and queries in SQL as well as transactions.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes)
if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

§ 49 (1) 1. b) Datenbanksysteme und Softwaretechnologie
§ 69 (1) 1. b) Datenbanksysteme und Softwaretechnologie

Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Mathematics (2012)
Bachelor' degree (1 major) Mathematics (2013)
Bachelor' degree (1 major) Business Information Systems (2013)
Bachelor' degree (1 major) Computational Mathematics (2012)
Bachelor' degree (1 major) Computational Mathematics (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Bachelor' degree (1 major) Functional Materials (2012)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Realschule Computer Science (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Data Mining			10-I-DM-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Foundations in the following areas: definition of data mining and knowledge, discovery in databases, process model, relationship to data warehouse and OLAP, data preprocessing, data visualisation, unsupervised learning methods (cluster and association methods), supervised learning (e. g. Bayes classification, KNN, decision trees, SVM), learning methods for special data types, other learning paradigms.

Intended learning outcomes

The students possess a theoretical and practical knowledge of typical methods and algorithms in the area of data mining and machine learning. They are able to solve practical knowledge discovery problems with the help of the knowledge acquired in this course and by using the KDD process. They have acquired experience in the use or implementation of data mining algorithms.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Business Information Systems (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Algorithmic Graph Theory			10-I-GT-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

We discuss typical graph problems: We solve round trip problems, calculate maximal flows, find matchings and colourings, work with planar graphs and find out how the ranking algorithm of Google works. Using the examples of graph problems, we also become familiar with new concepts, for example how we model problems as linear programs or how we show that they are fixed parameter computable.

Intended learning outcomes

The students are able to model typical problems in computer science as graph problems. In addition, the participants are able to decide which tool from the course helps solve a given graph problem algorithmically. In this course, students learn in detail how to estimate the run time of given graph algorithms.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2010)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Theory of Complexity			10-I-KT-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Mathematics (2012)
Bachelor' degree (1 major) Mathematics (2013)
Bachelor' degree (1 major) Computational Mathematics (2012)
Bachelor' degree (1 major) Computational Mathematics (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Computer Architecture			10-I-RAK-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Instruction set architectures, command processing through pipelining, statical and dynamic instruction scheduling, caches, vector processors, multi-core processors.

Intended learning outcomes

The students master the most important techniques to design fast computers as well as their interaction with compilers and operating systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

§ 69 (1) 1. c) Informatik Technische Informatik

Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Mathematics (2012)
Bachelor' degree (1 major) Mathematics (2013)
Bachelor' degree (1 major) Computational Mathematics (2012)
Bachelor' degree (1 major) Computational Mathematics (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Computer Networks and Communication Systems			10-I-RK-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science III		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).	

Contents

Properties of computer and communication systems: data traffic in distributed systems. Performance analysis of computer networks and communication systems: problem statement and introduction to method architecture and structure of computer networks: network structure, network access, access methods, digital transfer hierarchies, dataflow control and traffic control, transfer network. Communication protocols: fundamental principles and ISO architecture models. Internet: structure and basic mechanism, TCP/IP, routing, network management. Mobile communication networks: fundamental concepts, GSM, UMTS. Future communication systems and networks.

Intended learning outcomes

The students possess an intricate knowledge of the structure of computer networks and communication systems as well as fundamental principles to rate these systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 80 to 90 minutes). If announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups. A 80 to 90 minute written examination is equivalent to a 20 minute (approx.) oral examination of one candidate each, a 30 minute (approx.) oral examination in groups of 2 and a 40 minute (approx.) oral examination in groups of 3.
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Mathematics (2012)
Bachelor' degree (1 major) Mathematics (2013)
Bachelor' degree (1 major) Computational Mathematics (2012)
Bachelor' degree (1 major) Computational Mathematics (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)

Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Knowledge-based Systems			10-I-WBS-102-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Foundations in the following areas: knowledge management systems, knowledge representation, solving methods, knowledge acquisition, learning, guidance dialogue, semantic web.

Intended learning outcomes

The students possess theoretical and practical knowledge for the understanding and design of knowledge-based systems including knowledge formalisation and have acquired experience in a small project.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 50 to 60 minutes)
if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Computer Science (2010)
Bachelor' degree (1 major) Business Information Systems (2013)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Computer Science (2010)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Computational Mathematics (2012)
First state examination for the teaching degree Gymnasium Computer Science (2009)

Module title			Abbreviation
Applied Analysis			10-M=AAAN-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

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

Recommended previous knowledge:
Familiarity with the contents of the module "Functional Analysis" is strongly recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results of higher analysis. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics and other natural and engineering sciences.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Topics in Algebra			10-M=AALG-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Contemporary topics in algebra, for example coding theory, elliptic curves, algebraic combinatorics or computer algebra.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in a contemporary field of algebra, and is able to apply these skills to complex questions.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Differential Geometry			10-M=ADGM-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Central and advanced results in differential geometry, in particular about differentiable and Riemannian manifolds.

Recommended previous knowledge:
Basic knowledge from the modules "Introduction to Differential Geometry", "Introduction to Topology" and "Geometric Analysis" is recommended.

Intended learning outcomes

The student is acquainted with concepts and methods for differentiable manifolds or Riemannian manifolds, is able to apply these methods and knows about the interaction of local and global methods in differential geometry.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Complex Analysis			10-M=AFTH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

In-depth study of mapping properties of analytic functions and their generalisations with modern analytic and geometric methods. Structural properties of families of holomorphic and meromorphic functions. Special functions (e. g. elliptic functions).

Recommended previous knowledge:
Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results of higher complex analysis, in particular the (geometric) mapping properties of holomorphic functions. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Geometric Structures			10-M=AGMS-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Tits buildings, generalised polygons or related geometric structures, automorphisms, BN pairs in groups, Moufang conditions, classification results.

Recommended previous knowledge:
Basic knowledge from the modules "Introduction to Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results concerning a type of geometric structure. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Giovanni-Prodi Lecture (Master)			10-M=AGPC-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: English, German if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)
exchange program Mathematics (2023)

Module title			Abbreviation
Industrial Statistics 1			10-M=AIST-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Theory of parameter and domain estimates, tests for statistical estimates, distribution models, empirical distribution analysis, comparative analysis, statistical product testing, survey sampling, audit sampling.

Intended learning outcomes

The student masters the fundamental statistical methods for industrial applications.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Lie Theory			10-M=ALTH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Linear Lie groups and their Lie algebras, exponential function, structure and classification of Lie algebras, classic examples, applications, e. g. in physics and control theory.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Functional Analysis" and "Introduction to Topology" is recommended. Furthermore, basic knowledge of the contents of the module "Introduction to Differential Geometry" is useful.

Intended learning outcomes

The student is acquainted with the fundamental results, theorems and methods in Lie theory. He/She is able to apply these to common problems, and knows about the interactions of group theory, analysis, topology and linear algebra.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Numeric of large Systems of Equations			10-M=ANGG-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Discretisation of elliptic differential equations, classical iteration methods, preconditioners, multigrid methods.

Recommended previous knowledge:
Basic knowledge of numerical mathematics, such as that acquired in the modules "Numerical Mathematics 1" and "Numerical Mathematics 2", is required. Knowledge of the contents of the module "Basics in Optimization" is also recommended.

Intended learning outcomes

The student is acquainted with the most important methods for solving large systems of equations, and knows the most efficient way to solve a given system of equations.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Basics of Optimization			10-M=AOPT-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Fundamental methods and techniques in continuous optimization, unrestricted optimization, conditions for optimality, restricted optimization, examples and applications in natural and engineering sciences as well as economics.

Intended learning outcomes

The student knows the fundamental methods of continous optimization, can judge their strengths and weaknesses and can decide which method is the most suitable in applications.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Introduction to Control Theory			10-M=ARTH-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Introduction to mathematical systems theory: stability, controllability and observability, state feedback and stability, basics in optimal control.

Recommended previous knowledge:
Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of control theory. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 90 to 120 minutes); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German or English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Aerospace Computer Science (2009) Bachelor' degree (1 major) Aerospace Computer Science (2011) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Stochastic Models for Risk Analysis			10-M=ASMR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Measure theory, risk diagrams, failure mode and effects analysis, risk assessment in auditing, shortfall measures, value at risk, conditional value at risk, axiomatic of risk measures, modelling of interdependencies, copula, modelling of functional interrelations, regression models, basics in time series modelling, aggregated losses, estimates of shortfall measures, estimates of value at risk and conditional value at risk, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, estimates of value at risk in time series, elementary empirical regression analysis, simulation methods.

Intended learning outcomes

The student is acquainted with the fundamental methods of stochastic risk analysis.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Stochastical Processes			10-M=ASTP-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Markov chains, queues, stochastic processes in C[0,1], Brownian motion, Donsker's theorem, projective limits.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of stochastical processes and can apply them to practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Topology			10-M=ATOP-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Set-theoretic topology, topological invariants (e. g. fundamental group, connection), construction of topological spaces, covering spaces.

Intended learning outcomes

The student is acquainted with the fundamental results, theorems and methods in topology and is able to apply these to common problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Insurance Mathematics			10-M=AVSM-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

The module discusses policies on one life: distributions of future lifetime, life tables, life table approximations, types of benefits, present value, expection principle, premium calculation, commutation functions, reserves and policy values, expenses, bonus, recursive methods, Thiele's differential equation.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of statistics or stochastics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of life insurance mathematics and can apply them to practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Economathematics (2012) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Time Series Analysis 1			10-M=AZRA-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Additive model, linear filters, autocorrelation, moving average, autoregressive processes, Box-Jenkins method.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental methods of time series analysis and can apply them to practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Number Theory			10-M=AZTH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Number-theoretic functions and their associated Dirichlet series resp. Euler products, their analytic theory with applications to prime number distribution and diophantine equations; discussion of the Riemann hypothesis, overview of the development of modern number theory.

Recommended previous knowledge:
Basic knowledge of algebra and number theory is assumed, such as can be acquired in the modules "Introduction to Algebra", „Introduction to Number Theory“ and "Applied Algebra".

Intended learning outcomes

The student is acquainted with the fundamental methods of analytics number theory, can deal with algebraic structures in number theory and knows methods for the solution of diophantine equations. He/She has insight into modern developments in number theory.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Learning by teaching Mathematics 1			10-M=ELT1-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Supervising a tutorial or study group in the Bachelor's programme under guidance of the respective lecturer.

Intended learning outcomes

The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations.

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

Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

practical examination (approx. 90 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Learning by Teaching 2			10-M=ELT2-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Supervising a tutorial or study group in the Bachelor's programme under guidance of the respective lecturer.

Intended learning outcomes

The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations.

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

Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

practical examination (approx. 90 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Internship (Lab Course) Applied Mathematics			10-M=EPRK-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Module can only be taken if a lecturer from the Institute of Mathematics agrees to supervise the placement. He or she will register the student for assessment.	

Contents

Work placement in economy, industry, research or administration.

Intended learning outcomes

The student applies his/her skills obtained during his/her studies in the master programme to a specific practical problem in research, economy or industry.

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

P (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (oral: approx. 30 to 60 minutes, written: approx. 10 to 30 pages)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Study Group Algebra			10-M=GALG-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in algebra (e. g. ring theory, commutative algebra, differential algebra, local fields, computer algebra, algebras, division rings, quadratic forms).

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student gains insight into contemporary research problems in algebra. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Discrete Mathematics			10-M=GDIM-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in discrete mathematics.

Intended learning outcomes

The student gains insight into contemporary research problems in discrete mathematics. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Dynamical Systems and Control			10-M=GDSR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in dynamical systems and control theory.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in dynamical systems and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Complex Analysis			10-M=GFTH-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in complex analysis (e. g. in approximation theory, potential theory, complex dynamics, geometric complex analysis, value distribution theory).

Recommended previous knowledge:
Depending on the current focus of the course, knowledge from different areas of analysis is required. Consultation with the lecturer at the beginning of the course is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in complex analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Geometry and Topology			10-M=GGMT-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in geometry and topology.

Intended learning outcomes

The student gains insight into contemporary research problems in geometry and topology. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Mathematics in its Context			10-M=GMKX-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Reflection on mathematics in a cultural context, for example by discussing part of the history of mathematics, given by a historical period, a geographic region or a particular field of mathematics. Other possibilities arise from the connection of mathematics with literature, language, music, art or the media.

Intended learning outcomes

The student realises the cultural dimension of mathematics and its relation to other cultural fields.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Study Group Measure and Integral			10-M=GMUI-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Aspects of measure and integration theory: sigma algebras and Borel sets, volume and measure, measurable functions and Lebesgue integrals, selected applications, e. g. product measures (with Fubini's theorem and the transformation rule), Lp spaces and absolute continuity, measures on topological spaces.

Intended learning outcomes

The student gains insight into contemporary research problems in measure and integration theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Study Group Numerical Mathematics and Applied Analysis			10-M=GNMA-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected topics in numerical mathematics, applied analysis or scientific computing.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis and/or numerical mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student gains insight into a contemporary research problems in numerical mathematics or applied analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Study Group Robotic, Optimization and Control Theory			10-M=GROK-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in robotics, optimisation and control theory.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in robotics, optimization and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Study Group Statistics			10-M=GSTA-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in statistics.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended. Depending on the content of the course, other prior knowledge may also be helpful; consultation with the lecturer is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in statistics. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Study Group Time Series Analysis			10-M=GZRA-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in time series analysis.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in time series analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Study Group Number Theory			10-M=GZTH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

Selected modern topics in number theory (e. g. algebraic number theory, modular forms, diophantine analysis).

Recommended previous knowledge:
Basic knowledge of algebra and number theory is assumed, such as can be acquired in the modules "Introduction to Algebra", „Introduction to Number Theory“ and "Applied Algebra".

Intended learning outcomes

The student gains insight into contemporary research problems in numer theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V + S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 120 minutes, c) written examination (approx. 90 to 120 minutes), d) oral examination of one candidate each (approx. 20 minutes), e) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Master Thesis Mathematics			10-M=MAAR-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for assessment and assignment of topic in consultation with supervisor. The supervisor may make the successful completion of certain modules that are relevant for the respective topic a prerequisite for the assignment of the topic.	

Contents

Independently researching and writing on a topic in mathematics selected in consultation with the supervisor.

Intended learning outcomes

The student is able to work independently on a given mathematical topic and apply the skills and methods obtained during his/her studies in the master programme. He/She can write down the result of his/her work in a suitable form.

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

no courses assigned

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written thesis
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Seminar in Applied Differential Geometry			10-M=SADG-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in applied differential geometry.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the modules "Applied Differential Geometry", "Geometric Mechanics", "Pseudo-Riemannian and Riemannian Geometry" and "Lie Theory" is also recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Seminar in Algebra			10-M=SALG-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in algebra.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Seminar in Dynamical Systems and Control			10-M=SDSR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in dynamical systems and control.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Seminar in Complex Analysis			10-M=SFTH-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in complex analysis.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Complex Analysis" and " Complex Analysis" is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Seminar Financial and Insurance Mathematics			10-M=SFVM-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in financial and insurance mathematics.

Recommended previous knowledge:
Familiarity with the contents of the modules "Introduction to Stochastic Financial Mathematics" and "Stochastics 1" is strongly recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Seminar in Geometry and Topology			10-M=SGMT-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in geometry and topology.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Giovanni-Prodi Seminar (Master)			10-M=SGPC-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in the research expertise of the current holder of the Giovanni Prodi Chair.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Language of assessment: English, German if agreed upon with the examiner

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Interdisciplinary Seminar			10-M=SIDZ-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in mathematics with interdisciplinary aspects.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Seminar in Numerical Mathematics and Applied Analysis			10-M=SNMA-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in numerical mathematics or applied analysis.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis and/or numerical mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Seminar in Optimization			10-M=SOPT-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in optimisation.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Seminar in Statistics			10-M=SSTA-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the seminar must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Some seminars or workshops might only be open for students with previous knowledge and/or skills in certain areas. Where applicable, details will be specified in the class schedule.	

Contents

A modern topic in statistics.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended. Depending on the content of the course, other prior knowledge may also be helpful; consultation with the lecturer is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one or two of the following methods of assessment: a) seminar presentation (approx. 60 to 120 minutes), b) written elaboration of contents equivalent to a seminar presentation of approx. 60 to 90 minutes
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Algebraic Topology			10-M=VATP-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Homology, homotopy invariance, exact sequences, cohomology, application to the topology of Euclidean spaces.

Recommended previous knowledge:
Basic knowledge of topology is assumed, such as can be acquired in the module "Introduction to Topology".

Intended learning outcomes

The student is acquainted with advanced results in algebraic topology.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (approx. 90 to 120 minutes; usually chosen), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups of 2 candidates (approx. 30 minutes total)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)
exchange program Mathematics (2023)

Module title			Abbreviation
Discrete Mathematic			10-M=VDIM-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Advanced methods and results in a selected field of discrete mathematics (e. g. coding theory, cryptography, graph theory or combinatorics)

Recommended previous knowledge:
Basic knowledge of the contents of the module "Introduction to Discrete Mathematics" is required.

Intended learning outcomes

The student is acquainted with advanced results in a selected topic in discrete mathematics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Dynamical Systems and Control			10-M=VDSR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Basics in dynamical systems and control: non-linear dynamics, stability theory, ergodic theory, Hamiltonian systems; selected advanced topics, e. g. networked dynamical systems, non-linear stability, dynamics with restricted communication, entropy of dynamical systems.

Recommended previous knowledge:
Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student masters the mathematical methods in the theory of dynamic systems and control, and is able to analyse their quality.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Special Topics in Financial Mathematics			10-M=VFNM-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Selected topics in financial mathematics, e. g. conditional expectation and martingales, fundamental theorem of asset pricing in discrete time for finite spaces, American put, Snell envelope, stopping time, optimal stopping, stochastic integration, stochastic differential equations and Ito calculus, Black-Merton-Scholes model.

Recommended previous knowledge:
Familiarity with the contents of the modules "Introduction to Stochastic Financial Mathematics" and "Stochastics 1" is strongly recommended.

Intended learning outcomes

The student is acquainted with advanced results in financial mathematics. He/She gains the ability to work on contemporary research questions in financial mathematics and can apply his/her skills to complex problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (approx. 90 to 120 minutes; usually chosen), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups of 2 candidates (approx. 30 minutes total)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Groups and their Representations			10-M=VGDS-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Finite permutation groups and character theory of finite groups, interrelations and special techniques such as the S-rings of Schur.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in group theory and representation theory and can apply his/her skills to complex problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (approx. 90 to 120 minutes; usually chosen), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups of 2 candidates (approx. 30 minutes total)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Geometrical Mechanics			10-M=VGEM-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Introduction to geometric mechanics: basic notions of differential geometry and symplectic geometry, Euler-Lagrange equations, Hamiltonian mechanics on manifolds.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the module "Introduction to Topology" is also recommended. Knowledge of theoretical mechanics can also be useful.

Intended learning outcomes

The student is able to apply fundamental methods and concepts of geometry to problems in mechanics, and knows about the interrelation of these fields.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (approx. 90 to 120 minutes; usually chosen), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups of 2 candidates (approx. 30 minutes total)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Aspects of Geometry			10-M=VGEO-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

In-depth discussion of a special type of geometry taking into account recent developments and interrelations with other mathematical structures, e. g. topological geometries, diagram geometries.

Recommended previous knowledge:
Basic knowledge from the modules "Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is acquainted with advanced results in a selected field of geometry and can apply his/her skills to complex problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Basics in Mathematics			10-M=VGRM-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Discussion of problems and questions on the foundation of mathematics, applying methods of set theory, logic and philosophy.

Intended learning outcomes

The student is acquainted with the foundational methods in mathematics and logic.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Industrial Statistics 2			10-M=VIST-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Linear models, regression analysis, nonlinear regression, experimental design, basics in time series modelling, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, statistical process monitoring.

Intended learning outcomes

The student masters advanced statistical methods for industrial applications.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Field Arithmetics			10-M=VKAR-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Combination of Galois theory, group theory and the theory of function fields with the aim of application in number theory, e. g. topics around Hilbert's irreducibility theorem, permutation polynomials (e. g. Calitz-Wan-conjecture) and the inverse problem in Galois theory.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in algebra and can apply his/her skills to complex problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010)

Module title			Abbreviation
Mathematical Imaging			10-M=VMBV-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Mathematical fundamentals of image processing and computer vision such as elementary projective geometry, camera models and camera calibration, rigid and non-rigid registration, reconstruction of 3D objects from camera pictures; algorithms; module might also include an introduction to geometric methods and tomography.

Recommended previous knowledge:
Basic knowledge of functional analysis, such as that taught in the module "Functional Analysis", is recommended.

Intended learning outcomes

The student masters the mathematical methods in the theory of image processing and knows about their main fields of application.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Selected Topics in Mathematical Physics			10-M=VMPH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Selected topics in mathematical physics (e. g. differential equations of mathematical physics, probability theory, hydrodynamics, hyperbolic conservation equations, mathematical materials science, quantum mechanics).

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is acquainted with advanced results in a field in mathematical physics. He/She knows mathematical methods in mathematical physics and can apply them to solve problems in physics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Modul Theory			10-M=VMTH-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Basics in module theory: modules and module spaces, canonical decomposition and representations, simple, semi-simple and complex modules, module trees and their defibrations, distorsion theorems, reduction theorems.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters mathematical methods in module theory and is able to analyse their quality.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Non-Linear Analysis			10-M=VNAN-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Methods in nonlinear analysis (e. g. topological methods, monotony and variational methods) with applications.

Recommended previous knowledge:
We recommend basic knowledge of functional analysis and partial differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Applied Analysis".

Intended learning outcomes

The student is acquainted with the concepts of non-linear analysis, can compare them and assess their applicability on practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Numeric of Partial Differential Equations			10-M=VNPE-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Types of partial differential equations, qualitative properties, finite differences, finite elements, error estimates (numerical methods for elliptic, parabolic and hyperbolic partial differential equations; finite elements method, discontinuous Gelerkin finite elements method, finite differences and finite volume methods).

Recommended previous knowledge:
We recommend basic knowledge of functional analysis and partial differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Applied Analysis".

Intended learning outcomes

The student is acquainted with advanced methods for discretising partial differential equations.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Selected Topics in Optimization			10-M=VOPT-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Selected topics in optimization, e. g. inner point methods, semidefinite programs, non-smooth optimization, game theory, optimization with differential equations.

Intended learning outcomes

The student is acquainted with advanced methods in continuous optimization. He gains the ability to work on contemporary research questions in continuous optimization.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Optimal Control			10-M=VOST-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Basics in optimal control of ordinary and partial differential equations, theory of optimal control, conditions for optimality, methods for numerical solution.

Recommended previous knowledge:
We recommend basic knowledge of functional analysis and ordinary differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Ordinary Differential Equations". Knowledge of the contents of the module "Basics in Optimization" may also be useful.

Intended learning outcomes

The student is acquainted with advanced methods in optimal control. He gains the ability to work on contemporary research questions in continuous optimization.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Quantum Control and Quantum Computing			10-M=VQKC-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Basics in dynamics of quantum-mechanical systems (e. g. density operators, observables, Schrödinger equation, Liouville-von-Neumann equation), bilinear control systems in quantum mechanics (e. g. finite-dimensional spin systems and/or infinite-dimensional Schrödinger equations with external control), applications (e. g. in quantum computing or magnetic resonance spectroscopy).

Intended learning outcomes

The student is acquainted with advanced methods in quantum-mechanical control systems. He gains the ability to work on contemporary research questions in and applications of control systems in quantum mechanics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters.
Language of assessment: German, English

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Statistical Analysis			10-M=VSTA-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Contingency tables, categorical regression, one-factorial variance analysis, two-factorial variance analysis, discriminant function analysis, cluster analysis, principal component analysis, factor analysis.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental methods in statistical analysis and can apply them to practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011) Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Insurance Mathematics 2			10-M=VVSM-102-m01
Module coordinator			**Module offered by**
Dean of Studies Mathematik (Mathematics)			Institute of Mathematics
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

This module discusses modern valuation approaches and multiple decrement models regarding one life or two lives: modern valuation in life insurance mathematics, axiomatic derivation of the product measure approach, Markov chain models, Kolmogorov's differential equations, Thiele's differential equations, numerical applications, joint life policies.

Recommended previous knowledge:
Familiarity with the contents of the modules "Insurance Mathematics 1" and "Selected Topics in Financial Mathematics" is strongly recommended.

Intended learning outcomes

The student is acquainted with advanced methods in insurance mathematics. He gains the ability to work on contemporary research questions in insurance mathematics and can apply his/her skills to complex problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Networked Systems			10-M=VVSY-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Contemporary topics in networked linear and non-linear dynamical systems (homogenous and non-homogenous systems); analysis of control-theoretical aspects (controllability, accessibility, etc.).

Recommended previous knowledge:
Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student is acquainted with advanced methods in the field of networked systems. He gains the ability to work on contemporary research questions in networked systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Mathematical Physics (2012)

Module title			Abbreviation
Time Series Analysis 2			10-M=VZRA-102-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

State-space models, Kalman filter, frequency spaces, Fourier analysis, periodograms, characterisation of autocovariance functions.

Intended learning outcomes

The student is acquainted with advanced methods in time series analysis. He gains the ability to work on contemporary research questions in this field.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (90 to 120 minutes), b) oral examination of one candidate each (approx. 20 minutes), c) oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Economathematics (2011)

Module title			Abbreviation
Applied Semiconductor Physics			11-AHL-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

The lecture discusses the principles of Semiconductor Physics and provides an exemplary overview of the main components of electronics, optoelectronics and photonics.

Intended learning outcomes

The students know the characteristics of semiconductors, they have gained an overview of the electronic and phonon band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport as well as the Poisson, Boltzmann and continuity equation for the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the theories of planar technology and recent developments in this field, they have a basic understanding of component production. They understand the structure and way of functioning of the main components of electronics (diode, transistor, field-effect transistor, thyristor, diac, triac), of microwave applications (tunnel, Impatt, Baritt or Gunn diode) and of optoelectronics (photo diode, solar cell, light-emitting diode, semiconductor injection laser), they know the realisation possibilities of low-dimensional charge carrier systems on the basis of semiconductors and their technological relevance, they are familiar with current developments in the field of components.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload
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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010)

Module title			Abbreviation
Cosmology			11-AKM-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Expanding space-time, Friedmannian cosmology, basics of general relativity, the early universe, inflation, dark matter, primordial nucleosynthesis, cosmic microwave background, structure formation, supercluster, galaxies and galaxy clusters, intergalactic medium, cosmological parameters

Intended learning outcomes

The students have basic knowledge of cosmology. They know the theoretical methods of cosmology and are able to relate them to observations. They have gained insights into current research topics and are able to work on scientific questions.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Plasma-Astrophysics			11-APL-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Plasma Astrophysics: Dynamics of charged particles in electric and magnetic fields. Transport equations for energetic particles. Properties of magnetic turbulence. Propagation of solar particles within the solar wind. Particle acceleration via shock waves and via interaction with plasma turbulence. Particle acceleration and transport in galaxies and other cosmic objects.

Intended learning outcomes

The students have basic knowledge of Plasma Astrophysics. They have mastered the theoretical description of motion and acceleration of charged particles in space, they know corresponding measuring methods and can compare and evaluate theory and experiments.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Applied Superconduction			11-ASL-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Physical principles of superconductivity. Application in energy engineering. Instrumental developments. Methods of materials sciences for the calculation of temperature profiles in superconductors.

Intended learning outcomes

The students have a basic understanding of superconductivity as a macroscopic quantum phenomenon. They are able to evaluate the contributions of materials sciences to the development of superconductivity. They are able to discuss questions on superconductivity in a scientific manner and to critically question developments of energy technology. Furthermore, they can deal with practical mathematical questions.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: once a year, winter semester
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Nanostructure Technology (2010)
Bachelor' degree (1 major) Nanostructure Technology (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)

Module title			Abbreviation
Introduction to Space Physics			11-ASP-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

1. Overview
2. Dynamics of charged particles in magnetic and electric fields
3. Elements of space physics
4. The sun and heliosphere
5. Acceleration and transport of energetic particles in the heliosphere
6. Instruments to measure energetic particles in extraterrestrial space

Intended learning outcomes

The students have basic knowledge of Space Physics, in particular of the characterisation of the dynamics of charged particles in space and in the heliosphere. They know relevant parameters, theoretical concepts and measuring methods.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Atmosphere and Space Physics			11-AWP-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Structure of planetary atmospheres. Interaction of planetary atmospheres with the Sun. Physics of clouds. Planetary magnetospheres and interplanetary medium. (Micro) meteorites, asteroids, planetary rings. Atmospheres of exoplanets.

Intended learning outcomes

The students have knowledge of the physics of planetary atmospheres, especially of the atmosphere of the Earth and near-Earth space. They are able to apply the acquired knowledge to the solution of problems of interplanetary space missions.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German or English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Aerospace Computer Science (2009)
Bachelor' degree (1 major) Aerospace Computer Science (2011)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title	Abbreviation
Introduction to Plasmaphysics	11-EPP-092-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

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

Contents

Plasma Astrophysics: Dynamics of charged particles in electric and magnetic fields, Magnetohydrodynamics, Transport equations for energetic particles, Properties of magnetic turbulence, Propagation of solar particles within the solar wind, Particle acceleration via shock waves and via interaction with plasma turbulence, Particle acceleration and transport in galaxies and other astrophysical objects, Cosmic radiation.

Intended learning outcomes

The students know the principles of Plasma Physics, especially the description of transport phenomena in plasma. They are able to solve basic problems of Plasma Physics and to apply this knowledge to Astrophysics.

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

V + R (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Solid State Physics 2			11-FK2-092-m01
Module coordinator			**Module offered by**
Managing Director of the Institute of Applied Physics			Faculty of Physics and Astronomy
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Advanced Solid-State Physics. Electrons in periodic potential - the band structure. Dynamics in the semi-classical model. Dielectric properties and ferroelectrics. Semiconductors. Magnetism. Superconductivity. Coupled excitations and optical properties [optional]

Intended learning outcomes

The students have specific and advanced knowledge in the field of Solid-State Physics. They are theoretically able to specialise in a sub-discipline of Solid-State Physics.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Solid State Spectroscopy			11-FKS-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Single- and many-particle picture of electrons in solids. Light-matter interaction. Optical spectroscopy. Electron spectroscopy. X-ray spectroscopies.

Intended learning outcomes

The students have specific and advanced knowledge in the field of solid-state spectroscopy. They know different types of spectroscopy and their fields of application. They understand the theoretical principles and the current developments in research.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Nanostructure Technology (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Transport Phenomena in Solids			11-FKT-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Transport phenomena in solids.

Intended learning outcomes

The students have specific and advanced knowledge in the field of transport phenomena in solids.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)

Module title			Abbreviation
Group Theory			11-GRT-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Group theory. Finite groups. Lie groups. Lie algebra. Depiction. Tensors. Classification theorem. Applications.

Intended learning outcomes

The students know the basics of group theory, especially of Lie groups. They are able to identify problems of group theory and to solve them by using the acquired methods. They are able to apply group theory to the formulation and processing of physical problems.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Semiconductor Nanostructures			11-HNS-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Semiconductor nanostructures are frequently referred to as "artificial materials". In contrast to atoms, molecules or macroscopic crystals, their electronic, optical and magnetic properties can be systematically tailored by changing their size. The lecture addresses technological challenges in the preparation of semiconductor nanostructures of varying dimensions (2D, 1D, 0D). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.

Intended learning outcomes

The students know the theoretical principles and characteristics of semiconductor nanostructures. They have knowledge of the technological methods to fabricate such structures, and of their applications to novel photonic devices. They are able to apply their knowledge to problems in this field of research.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Technology of Functional Materials (2010) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) Computational Mathematics (2012) Master's degree (1 major) Functional Materials (2012)

Module title			Abbreviation
Magnetism			11-MAG-092-m01
Module coordinator			**Module offered by**
Managing Director of the Institute of Applied Physics			Faculty of Physics and Astronomy
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain structure, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo effect.

Intended learning outcomes

The students know basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas; they have competencies in independently working on problems of these areas; they are able to evaluate the accuracy of observations and analyses.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Nanostructure Technology (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)

Module title			Abbreviation
Low-Dimensional Structures			11-NDS-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Low-dimensional structures: Crystal lattice symmetry. Lattice dynamics and growth techniques of low-dimensional structures. Comparison between these structures and volume solids. X-ray diffractometry. Molecular beam epitaxy.

Intended learning outcomes

The students have knowledge of the theoretical principles of the growth of low dimensional structures. They know methods of producing and analysing such structures. They know the bandstructures of the most important semiconductors as well as the fabrication and characteristics of semiconductor heterostructures and MOS-diodes. They are familiar with the subband structure of semiconductor heterostructures and MOS-diodes and can evaluate the importance of many-particle effects. They are able to solve problems related to potentials in one dimension by applying Poisson's equation. They know the k*p perturbation theory and can deduce the 2D subband structure from the bulk band structure. They have knowledge of the meaning of modulation doping and are familiar with the 2D hydrogen atom. They understand how an external magnetic field acts on the properties of a free electron gas in 2D. They have basic knowledge of the meaning of gauging, Landau-quantisation, filling factor and Landau degeneracy. They understand the dependence of various physical properties on the filling factor, and are able to solve implicit problems via numerical methods. They are familiar with elementary excitations in two-dimensional systems.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Workload
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011)

Module title			Abbreviation
Numerical Methods in Astrophysics			11-NMA-092-m01
Module coordinator			**Module offered by**
Managing Director of the Institute of Theoretical Physics and Astrophysics			Faculty of Physics and Astronomy
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Various methods used in astrophysical simulations with special emphasis on their applications. N-body algorithms (tree- and polynomial codes). Particle-mesh methods (particle-in-cell methods). Vlasow methods (e.g., Lattice-Boltzmann). Hyperbolic conservation laws (fluid dynamics, finite difference method, Riemann solver, ENO). Methods of high-performance computing. Message-passing interface (MPI). GPGPU programming (OpenCL).

Intended learning outcomes

The students are able to solve typical problems and equations of Astrophysics and other subdisciplines of Physics with the help of numerical simulations. They are especially capable of choosing adequate strategies to approach such problems and of validating the results.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Mathematical Physics (2009) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010)

Module title			Abbreviation
Nano-Optics			11-NOP-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Theoretical principles. Focussing of light. Microscopy. Optical nearfield probes. Nearfield microscopy. Single quantum emitters. Light emission in nano-tailored environments. Plasmons. Optical antennas.

Intended learning outcomes

The students have specific and advanced knowledge in the field of nano-optics. They are familiar with the theoretical principles and application areas of nano-optics and with current developments in this field.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)

Module title			Abbreviation
Physics of Complex Systems			11-PKS-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

1. Theory of critical phenomena in thermal equilibriumt
2. Introduction into the physics out of equilibriumt
3. Entropy production and fluctuationst
4. Phase transitions away from equilibriumt
5. Universalityt
6. Spin glassest
7. Theory of neural networks

Intended learning outcomes

The students have specific and advanced knowledge in the field of physics of complex systems. They know the methods of Statistical Physics, Computational Physics and non-linear dynamics, which are used to describe such systems. They are able to work on current research problems in this area.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Bachelor' degree (1 major) Nanostructure Technology (2012) Bachelor' degree (1 major) Mathematical Physics (2009) Bachelor' degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011)

Module title	Abbreviation
Quantum Mechanics II	11-QM2-092-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

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

Contents

"Quantum mechanics II" constitutes the central theoretical course of the international Master's program in Physics. It builds upon basics which are acquired in the lecture "Quantum mechanics I" of the Bachelor's degree. While the specific emphasis can be adjusted individually, the core topics that are supposed to be covered should include:
1. Second quantisation: Fermions and bosons
2. Band structures of particles in a crystal
3. Angular momentum, symmetry operators, Lie Algebras
4. Scattering theory: Potential scattering, partial wave expansion
5. Relativistic quantum mechanics: Klein-Gordon equation, Dirac equation, Loretz group, fine structure splitting of atomic spectra
6. Quantum entanglement
7. Canonical formalism

Intended learning outcomes

The students acquire in-depth knowledge of advanced quantum mechanics and have a thorough understanding of the mathematical and theoretical concepts of the listed topics. They are able to describe or model problems of modern theoretical Quantum Physics mathematically, to solve problems analytically, to use approximation methods and to interpret the results physically. The course is pivotal to subsequent theory courses in Astrophysics, High-Energy Physics and Condensed Matter/Solid-State Physics. The course is mandatory for all Master's students.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places
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Additional information
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Workload
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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Bachelor' degree (1 major) Nanostructure Technology (2012) Bachelor' degree (1 major) Mathematical Physics (2009) Bachelor' degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Quantum Phenomena in electronic correlated Materials			11-QPM-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Quantum effects and phenomena in current solid-state research. Correlations. Free electron gas and Fermi liquid. Strongly correlated systems

Intended learning outcomes

The students have specific, advanced knowledge of the current research on Solid-State Physics, especially on quantum effects in strongly correlated systems. They are able to understand the connections between the theoretical description of such systems and the current experimental results.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)

Module title	Abbreviation
Many Body Quantum Theory	11-QVTP-092-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

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

Contents

This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions.
An outline could be:

1 Single-particle Green's function
2 Review of second quantization
3 Diagrammatic method using many particle Green's functions at temperature T=0
4 Diagrammatic method for finite T
5 Landau theory of Fermi liquids
6 Superconductivity
7 One-dimensional systems and bosonization

Intended learning outcomes

The students have mastered the principles of quantum field theory in many-particle systems. They are able to apply the acquired methods to current problems of Theoretical Solid-State Physics.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload
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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Bachelor' degree (1 major) Mathematical Physics (2009) Bachelor' degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011)

Module title	Abbreviation
Relativistic Effects in Mesoscopic Systems	11-RMS-092-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

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

Contents

Relativistic effects in mesoscopic systems. - Spin-orbit coupling. - Dirac equation. - Quantum Hall effect. - Topological insulators. - Majorana fermions

Intended learning outcomes

The students have mastered the mathematical methods for the description of relativistic quantum systems, especially in the field of mesoscopic physics. They are able to apply their knowledge to simple systems.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)

Module title	Abbreviation
Renormalization Theory	11-RNT-092-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

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

Contents

Renormalisation group methods for Hamiltonian systems. Partial non-linear differential equations with scaling behaviour for dynamics beyond the equilibrium. Classical-critical and quantum-critical phenomena and their relevance for phase diagrams in cryogenic temperatures. Instability of statistical and dynamic mean-field solutions. Stochastic non-linear partial differential equations. Construction of generating functionals. Halperin-Hohenberg-Ma differential equations. Symmetries, e.g. in the stochastic Burgers' equation (KPZ equation). Introduction and comparison of different RG methods.

Intended learning outcomes

The students have gained an overview of renormalisation group methods for non-linear partial differential equations. They know important examples and corresponding solving methods and are able to apply them to specific tasks.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Bachelor' degree (1 major) Mathematical Physics (2009) Bachelor' degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Relativistical Quantumfield Theory			11-RQFT-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Symmetries. Lagrange formalism for fields. Field quantisation. Gauge principle and interaction. Perturbation theory. Feynman rules. Quantum electrodynamic processes in Born approximation. Radiative corrections and renormalisation.

Intended learning outcomes

The students have mastered the principles and underlying mathematics of relativistic quantum field theories. They know how to use perturbation theory and how to apply Feynman rules. They are able to calculate basics processes in the framework of quantum electrodynamics in leading order. Moreover, they have a basic understanding of radiative corrections and renormalisation.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Theory of Relativity			11-RTT-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Mathematical foundations of the theory of relativity; differential forms; brief summary of special relativity; elements of differential geometry; electrodynamics as an example of a relativistic gauge theory; field equations of general relativity; stellar models; introduction to cosmology; Hamiltonian formulation

Intended learning outcomes

The students are familiar with the basic physical and mathematical concepts of general relativity. They have a mathematical understanding of the formulation of general relativity on the basis of differential forms. They are able to apply the acquired knowledge to problems of Astrophysics and cosmology.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Statistics, Data Analysis and Computer Physics			11-SDC-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Statistics, data analysis and computer physics.

Intended learning outcomes

The students have specific and advanced knowledge in the field of statistics, data analysis and Computational Physics.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in

Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)
Bachelor' degree (1 major) Nanostructure Technology (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Supersymmetry I and II			11-SUS-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Supersymmetry I: Grassmann variable. Coleman-Mandula theorem and Haag-Lopuszanski-Sohnius theorem. Supersymmetry: Algebra and multiplets. Superfield formalism. Breaking of supersymmetry.
Supersymmetry II: Minimal supersymmetric standard model. Higgs sector. The spectrum of supersymmetric particles. Phenomenology of LEP, Tevatron and LHC, supersymmetric neutrino mass models. Violation of R-parity.

Intended learning outcomes

The students have knowledge of the mathematical and physical principles of supersymmetry and supersymmetric models. They understand the theory's formalism and recognise its connections to other models as well as its importance for phenomenology of elementary particles.

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

V + R (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)
Master's degree (1 major) FOKUS Physics (2006)

Module title			Abbreviation
Theoretical Elementary Particle Physics			11-TEP-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Fundamental forces and particles. Groups and symmetries. Quark model. Principles of quantum field theory. Gauge theories. Spontaneous symmetry breaking. Electroweak standard model. Quantum chrome dynamics. Extensions of the standard model.

Intended learning outcomes

The students are familiar with the mathematical methods of Elementary Particle Physics. They understand the structure of the standard model based on symmetry principles and experimental observations. They know calculation methods for the processing of simple problems and processes of Elementary Particle Physics. Furthermore, they know the tests and limits of the standard model and the basics of extended theories.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Theoretical Solid State Physics			11-TFK-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Principles of Theoretical Solid-State Physics. Fermi liquid theory. Electron-electron interaction. Variational methods. Magnetism. Superconductivity.

Intended learning outcomes

The students have basic knowledge of the theoretical description of solid-state phenomena. They know the corresponding mathematical or theoretical methods and are able to apply them to basic problems of solid-state theory and to understand the connections to experimental results. The individual students have elaborated on an advanced topic of solid-state theory and have discussed this topic in a seminar presentation.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Nanostructure Technology (2011)
Master's degree (1 major) Nanostructure Technology (2010)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Experimental Particle Physics			11-TPE-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Physics with modern particle detectors at the LHC and at the Tevatron. Discovery of the Higgs boson. Search for supersymmetry and other physics beyond the standard model. Determination of the top quark mass and W mass as well as other parameters of the standard model. Introduction to modern methods of analysis and assessment of systematic errors.

Intended learning outcomes

The students are familiar with the principles of modern particle detector physics, especially with currently open questions of Particle Physics, which are examined by using these detectors. They know modern methods of analysis and are able to put results into context and to assess their systematic uncertainties.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Master's degree (1 major) Mathematics (2012)
Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Particle Physics (Standard Model)			11-TPS-092-m01
Module coordinator		**Module offered by**	
Managing Directors of the Institute of Applied Physics and the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Introduction to the theory of electroweak interaction and spontaneous symmetry breaking. Experiments on the standard model and determination of model parameters.

Intended learning outcomes

The students know the theoretical fundamental laws of the standard model of Particle Physics and the key experiments that have established and confirmed the standard model. They are able to interpret experimental or theoretical results in the framework of the standard model and know its validity and limits.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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

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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
Bachelor' degree (1 major) Mathematical Physics (2009)
Bachelor' degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) Mathematics (2012)
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Master's degree (1 major) Physics (2010)
Master's degree (1 major) Physics (2011)
Master's degree (1 major) Mathematical Physics (2012)
Master's degree (1 major) FOKUS Physics (2010)
Master's degree (1 major) FOKUS Physics (2011)
Master's degree (1 major) Computational Mathematics (2012)

Module title			Abbreviation
Theory of Superconduction			11-TSL-092-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.	

Contents

Introduction to the phenomenom of superconductivity. Microscopic theory of superconductivity (BCS theory). Phenomenological theory of superconductivity (Ginzburg-Landau theory). Mesoscopic aspects of superconductivity (Andreev scattering, Bobolioubov-de Gennes equation, SQUIDS). Quantum computing with superconductive elements.

Intended learning outcomes

The students have basic knowledge of the theoretical models for the description of superconductivity. They know the properties and application areas of these models and are able to apply calculation methods to simple problems.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places

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Additional information

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Workload

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Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor' degree (1 major) Physics (2010)
Bachelor' degree (1 major) Physics (2012)
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Master's degree (1 major) Computational Mathematics (2012)