

Subdivided Module Catalogue
for the Subject
Computational Mathematics
as a Master's with 1 major
with the degree "Master of Science"
(120 ECTS credits)

Examination regulations version: 2012
Responsible: Institute of Mathematics

Course of Studies - Contents and Objectives

The Master programme Computational Mathematics is offered by the Department of Mathematics, with a total of currently (as of March 2014) 11 chairs.

The Master study programme in Computational Mathematics is intended to provide the students with the following qualifications:

- capacity of abstraction,
- rigour in analytic reasoning,
- excellent capacity to realize the structure of complex interrelations,
- sound qualification in applying mathematical methods to specific problems,
- insight into the intrinsic mathematical interdependence of different mathematical fields, in particular in Applied Mathematics, as well as into interdisciplinary relations in computer science, medicine, natural and engineering sciences,
- high capacity in problem solving,
- ability to carry out scientific work independently and on a high level,
- ability to cooperate responsibly within an interdisciplinary team of mathematicians, computer scientists, medical and natural scientists and engineers,
- ability to apply mathematical methods and algorithms, in particular from modelling, optimisation, simulation and scientific computing, in the context of life science, natural science or engineering,
- insight into and overview over current research in at least one field of contemporary mathematics,
- qualification for meeting the standards of a Ph.D. programme in mathematics (if applicable).

For the Master thesis the student works independently on a topic in Applied Mathematics and solves a problem within a limited time frame, following scientific criteria and applying established methods or modifying them if necessary.

The Master exam ascertains that the candidate has a good overview in the field of Computational Mathematics and possesses the ability to use the corresponding scientific methods independently. The degree Master of Science in Computational Mathematics constitutes a further professional and 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)):

12-Jul-2012 (2012-106)

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
Compulsory Electives (90 ECTS credits)				
Compulsory Electives Mathematics				
Applied Mathematics				
10-M=VKOM-122-m01	Mathematical Continuum Mechanics	5	NUM	109
10-M=AAAN-102-m01	Applied Analysis	10	NUM	65
10-M=ANGG-102-m01	Numeric of large Systems of Equations	10	NUM	79
10-M=AOPT-102-m01	Basics of Optimization	10	NUM	81
10-M=VNPE-102-m01	Numeric of Partial Differential Equations	10	NUM	117
10-M=VOPT-102-m01	Selected Topics in Optimization	10	NUM	119
10-M=VMPPH-102-m01	Selected Topics in Mathematical Physics	5	NUM	113
10-M=VOST-102-m01	Optimal Control	5	NUM	121
Mathematics				
10-M=VANA-122-m01	Selected Topics in Analysis	10	NUM	101
10-M=VGPC-122-m01	Giovanni-Prodi Lecture Selected Topics (Master)	10	NUM	107
10-M=ELTCM-122-m01	Learning by Teaching Computational Mathematics	5	NUM	91
10-M=ARTH-102-m01	Introduction to Control Theory	10	NUM	83
10-M=AALG-102-m01	Topics in Algebra	10	NUM	67
10-M=ADGM-102-m01	Differential Geometry	10	NUM	69
10-M=AFTH-102-m01	Complex Analysis	10	NUM	71
10-M=AGMS-102-m01	Geometric Structures	10	NUM	73
10-M=ALTH-102-m01	Lie Theory	10	NUM	77
10-M=ASTP-102-m01	Stochastical Processes	10	NUM	85
10-M=ATOP-102-m01	Topology	10	NUM	87
10-M=AZTH-102-m01	Number Theory	10	NUM	89
10-M=AGPC-102-m01	Giovanni-Prodi Lecture (Master)	5	NUM	75
10-M=VGDS-102-m01	Groups and their Representations	10	NUM	105
10-M=VDSR-102-m01	Dynamical Systems and Control	5	NUM	103
10-M=VMBV-102-m01	Mathematical Imaging	5	NUM	111
10-M=VNAN-102-m01	Non-Linear Analysis	5	NUM	115
Workshops and Seminars				
10-M=GMNW-122-m01	Study Group Mathematics in the Sciences	10	NUM	92
10-M=SMNW-122-m01	Seminar in Mathematics in the Sciences	5	NUM	98
10-M=GNMA-102-m01	Study Group Numerical Mathematics and Applied Analysis	10	NUM	93
10-M=GROK-102-m01	Study Group Robotic, Optimization and Control Theory	10	NUM	94
10-M=SGPC-102-m01	Giovanni-Prodi Seminar (Master)	5	NUM	96
10-M=SIDZ-102-m01	Interdisciplinary Seminar	5	NUM	97
10-M=SNMA-102-m01	Seminar in Numerical Mathematics and Applied Analysis	5	NUM	99
10-M=SOPT-102-m01	Seminar in Optimization	5	NUM	100
Application-oriented Subject				
Application-oriented Subject Biology				
Topics: Bioinformatics				
07-MBI-B-121-m01	Bioinformatics B	5	B/NB	9

07-MS2BI-102-m01	Bioinformatics (Lecture and Seminar)	10	NUM	10
07-MS2BIF1-102-m01	Bioinformatics (Practical Course and Seminar 1)	10	NUM	11
07-MS2BIF2-102-m01	Bioinformatics (Practical Course and Seminar 2)	15	B/NB	12
Topics: System Biology				
07-MS-B-121-m01	Systems Biology B	5	B/NB	16
07-MS3S-102-m01	System Biology (Lecture and Seminar)	10	NUM	13
07-MS3SYF1-102-m01	System Biology (Practical Course and Seminar 1)	10	NUM	14
07-MS3SYF2-102-m01	System Biology (Practical Course and Seminar 2)	15	B/NB	15
Application-oriented Subject Chemistry				
Theoretical Chemistry				
08-TCM2-102-m01	Computational Chemistry	5	NUM	27
08-TCM1-102-m01	Theoretical Chemistry	5	NUM	26
08-TCM3-102-m01	Programming in Theoretical Chemistry	5	NUM	28
08-TCAP-102-m01	Theoretical Chemistry - Project work	10	B/NB	24
Physical Chemistry				
08-PCM1-102-m01	Advanced Physical Chemistry	10	NUM	17
08-PCM2-102-m01	Chemical Dynamics	5	NUM	19
08-PCM3-102-m01	Nanoscale Materials	5	NUM	20
08-PCM4-102-m01	Ultrafast spectroscopy and quantum-control	5	NUM	21
08-PCM5-102-m01	Physical chemistry of supramolecular assemblies	5	NUM	22
08-PCM6-102-m01	Physical Chemistry (Advanced Lab)	5	B/NB	23
Application-oriented Subject Medicine				
03-MaMed1-122-m01	Applied Mathematics and Medicine	10	NUM	7
03-MaMed2-122-m01	Practical Research Course Medicine and Computational Mathematics	15	NUM	8
Application-oriented Subject Computer Science				
10-I-AGT-122-m01	Algorithmic Graph Theory	5	NUM	52
10-I-DB-102-m01	Databases	5	NUM	55
10-I-WBS-102-m01	Knowledge-based Systems	5	NUM	64
10-I-DM-102-m01	Data Mining	5	NUM	57
10-I-KT-102-m01	Theory of Complexity	5	NUM	58
10-I-AR-102-m01	Automation and Control Technology	8	NUM	53
10-I-RK-102-m01	Computer Networks and Communication Systems	8	NUM	62
10-I=KI-102-m01	Artificial Intelligence	8	NUM	41
10-I=EL-102-m01	E-Learning	5	NUM	38
10-I=MI-102-m01	Medical Informatics	5	NUM	43
10-I=DDB-102-m01	Deductive Databases	8	NUM	37
10-I=DB2-102-m01	Databases II	5	NUM	36
10-I=ST-102-m01	Simulation Techniques for Performance Evaluation	8	NUM	51
10-I=KT2-102-m01	Advanced Topics in Computational Complexity	8	NUM	42
10-I=KD-102-m01	Cryptography and Data Security	5	NUM	40
10-I=AG-102-m01	Computational Geometry	5	NUM	30
10-I=APA-102-m01	Approximation Algorithms	5	NUM	32
10-I=AGIS-102-m01	Algorithms for Geographic Information Systems	5	NUM	31
10-I=CB-102-m01	Compiler Construction	8	NUM	35
10-I=PA-102-m01	Program Design and Analysis	5	NUM	45
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10-I=RAM-102-m01	Computer Arithmetic	5	NUM	46
10-I=AUT-102-m01	Automata Theory	5	NUM	33
10-I=BER-102-m01	Computability Theory	5	NUM	34
10-I=ML-102-m01	Mathematical Logic	5	NUM	44
Application-oriented Subject Aerospace Computer Science				
10-I-AR-102-m01	Automation and Control Technology	8	NUM	53
10-I-RAK-102-m01	Computer Architecture	5	NUM	60
10-I-RK-102-m01	Computer Networks and Communication Systems	8	NUM	62
10-I=ES-102-m01	Embedded Systems	8	NUM	39
10-I=RO-102-m01	Robotics	8	NUM	47
10-I=SSD-102-m01	Spacecraft Systems Design	8	NUM	50
10-I=AA-102-m01	Advanced Automation	8	NUM	29
10-I=RO2-102-m01	Robotics II: Networked Robots	8	NUM	49
Application-oriented Subject Physics				
Solid State Physics and Nanostructures (Experiment)				
11-HLF-092-m01	Semiconductor Lasers - Principles and Current Research	6	NUM	141
11-FK2-092-m01	Solid State Physics 2	8	NUM	135
11-FKS-092-m01	Solid State Spectroscopy	6	NUM	137
11-HLP-092-m01	Semiconductor Physics	6	NUM	143
11-HNS-092-m01	Semiconductor Nanostructures	6	NUM	145
11-SPD-102-m01	Semiconductor Physics and Devices	6	NUM	159
Astrophysics and Particle Physics (Experiment)				
11-A4-072-m01	Astrophysics	6	NUM	123
11-AWP-092-m01	Atmosphere and Space Physics	6	NUM	131
11-TPE-092-m01	Experimental Particle Physics	4	NUM	167
11-TPS-092-m01	Particle Physics (Standard Model)	8	NUM	169
Complex Systems, Quantum Control and Biophysics (Experiment)				
11-SDC-092-m01	Statistics, Data Analysis and Computer Physics	4	NUM	157
Solid State Physics and Nanostructures (Theory)				
11-QM2-092-m01	Quantum Mechanics II	8	NUM	149
11-TFK-092-m01	Theoretical Solid State Physics	8	NUM	165
11-TSL-092-m01	Theory of Superconduction	5	NUM	171
Astrophysics and Particle Physics (Theory)				
11-EPP-092-m01	Introduction to Plasmaphysics	6	NUM	133
11-AKM-092-m01	Cosmology	6	NUM	125
11-APL-092-m01	Plasma-Astrophysics	6	NUM	127
11-ASP-092-m01	Introduction to Space Physics	6	NUM	129
11-GRT-092-m01	Group Theory	6	NUM	139
11-RNT-092-m01	Renormalization Theory	6	NUM	151
11-RQFT-092-m01	Relativistical Quantumfield Theory	8	NUM	153
11-RTT-092-m01	Theory of Relativity	6	NUM	155
11-TEP-092-m01	Theoretical Elementary Particle Physics	8	NUM	163
11-SUS-092-m01	Supersymmetry I and II	6	NUM	161
11-NMA-111-m01	Computational Astrophysics	6	NUM	147
Thesis (30 ECTS credits)				
10-M=MACM-102-m01	Master Thesis Computational Mathematics	30	NUM	95
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Module title		Abbreviation
Applied Mathematics and Medicine		03-MaMed1-122-m01
Module coordinator		Module offered by
Chair of Rudolf Virchow Center for Experimental Biomedicine		Faculty of Medicine
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Applications of mathematical modelling and analysis in medicine and, in particular, in genomics, proteomics, cellular modelling and quantitative image analysis.		
Intended learning outcomes		
Students have acquired an insight into various application areas of applied mathematics in the life sciences.		
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)		
talk (approx. 60 to 120 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) Computational Mathematics (2012)		

Module title		Abbreviation
Practical Research Course Medicine and Computational Mathematics		03-MaMed2-122-m01
Module coordinator		Module offered by
Chair of Rudolf Virchow Center for Experimental Biomedicine		Faculty of Medicine
ECTS	Method of grading	Only after succ. compl. of module(s)
15	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Practical application of mathematical and bioinformatic methods in biomedical research projects.		
Intended learning outcomes		
Students have gained practical experience in the application areas of applied mathematics in the life sciences.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
talk (approx. 60 to 120 minutes) and project report (approx. 10 to 20 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) Computational Mathematics (2012)		

Module title		Abbreviation
Bioinformatics B		07-MBI-B-121-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
5	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Advances and current results of bioinformatics are explained and discussed, this includes results from genome and sequence analysis, protein domains and protein families, large-scale data analysis (e. g. net generation sequences, proteomics data), analysis of different functional RNAs (e. g. miRNAs, lncRNAs).		
Intended learning outcomes		
Understand recent results in bioinformatics. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions in bioinformatics.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
Students will be informed about the method, length and scope of the assessment prior to the course. a) written examination (30 to 60 minutes, including multiple choice questions) or b) oral examination of one candidate each (30 to 60 minutes) or c) oral examination in groups of up to 3 candidates (30 to 60 minutes)		
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) Biology (2011) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Biomedicine (2013) Master's degree (1 major) Biomedicine (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
Bioinformatics (Lecture and Seminar)		07-MS2BI-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Advances and current results of bioinformatics are explained and discussed, this includes results from genome and sequence analysis, protein domains and protein families, large-scale data analysis (e. g. net generation sequences, proteomics data), analysis of different functional RNAs (e. g. miRNAs, lncRNAs).		
Intended learning outcomes		
Understand recent results in bioinformatics. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions in bioinformatics.		
Courses (type, number of weekly contact hours, language — if other than German)		
S + 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)		
Students will be informed about the method, length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) oral examination of one candidate each (30 to 60 minutes) or c) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes)		
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) Biochemistry (2012) Master's degree (1 major) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
Bioinformatics (Practical Course and Seminar 1)		07-MS2BIF1-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Detailed insight into methods in bioinformatics; depending on the topic selected, fields covered include: genomics (sequence-, domain analysis and annotation), omics data analysis (NGS, transcriptomics, metabolomics, proteomics), topological and structural analysis of biological interactions including statistical methods, phylogenetic analysis, protein structure analysis. Results are documented in the form of a presentation, a publication or a term paper.		
Intended learning outcomes		
Students have gained knowledge on experimental setups and methods used in the field of bioinformatics. They are able to design experiments, collect data and interpret them statistically, adhering to the principles of good scientific practice.		
Courses (type, number of weekly contact hours, language — if other than German)		
S + 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)		
Students will be informed about the length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) log (approx. 10 to 30 pages) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes) or e) presentation (20 to 45 minutes)		
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) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
Bioinformatics (Practical Course and Seminar 2)		07-MS2BIF2-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
15	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Admission prerequisite to assessment: regular attendance of lab course and successful completion of the respective exercises as specified at the beginning of the course.
Contents		
Advanced insight into methods in bioinformatics; depending on the topic selected, fields covered include: genomics (sequence-, domain analysis and annotation), omics data analysis (NGS, transcriptomics, metabolomics, proteomics), topological and structural analysis of biological interactions including statistical methods, phylogenetic analysis, protein structure analysis. The techniques applied are evaluated on the basis of the results obtained and are modified where necessary. Results are documented in the form of a presentation, a publication or a term paper.		
Intended learning outcomes		
Proficiency in one or more methods in bioinformatics that allows students to independently perform and organise a scientific project in the field of bioinformatics and to document the results obtained. Students are able to design a research project and are prepared for working on a scientific question for their thesis.		
Courses (type, number of weekly contact hours, language — if other than German)		
S + 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)		
Students will be informed about the length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) log (approx. 10 to 30 pages) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes) or e) presentation (20 to 45 minutes)		
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) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
System Biology (Lecture and Seminar)		07-MS3S-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Advances and current results of computational systems biology are explained and discussed, this includes results from functional genomics, dynamics of the transcriptome, of metabolism and metabolic networks as well as regulatory networks.		
Intended learning outcomes		
Understand recent results in systems biology. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions of systems biology.		
Courses (type, number of weekly contact hours, language — if other than German)		
S + 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)		
Students will be informed about the method, length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) oral examination of one candidate each (30 to 60 minutes) or c) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes)		
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) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
System Biology (Practical Course and Seminar 1)		07-MS3SYF1-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>The practical course will provide students with advanced insights into a field of systems biology and will, in particular, make students proficient in a dynamical method in systems biology (areas that may be selected include protein structure analysis and protein folding, genome analysis and evolution; dynamic network analysis, the dynamics of protein-protein interactions, modelling cellular regulation; modelling metabolism, statistical modelling).</p>		
Intended learning outcomes		
<p>Students have gained knowledge on experimental setups and methods used in the field of systems biology. They are able to design scientific research, to collect data and to interpret them statistically, adhering to the principles of good scientific practice.</p>		
Courses (type, number of weekly contact hours, language — if other than German)		
P + 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)		
<p>Students will be informed about the length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) log (approx. 10 to 30 pages) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes) or e) presentation (20 to 45 minutes)</p>		
Allocation of places		
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Additional information		
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Workload		
--		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
<p>Master's degree (1 major) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)</p>		

Module title		Abbreviation
System Biology (Practical Course and Seminar 2)		07-MS3SYF2-102-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
15	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Admission prerequisite to assessment: regular attendance of lab course and successful completion of the respective exercises as specified at the beginning of the course.
Contents		
<p>The practical course will provide students with advanced insights into a field of systems biology and will, in particular, make students proficient in a dynamical method in systems biology (areas that may be selected include protein structure analysis and protein folding, genome analysis and evolution; dynamic network analysis, the dynamics of protein-protein interactions, modelling cellular regulation; modelling metabolism, statistical modelling). The techniques applied are evaluated on the basis of the results obtained and are modified where necessary. Results are documented in the form of a presentation, a publication or a term paper.</p>		
Intended learning outcomes		
<p>Proficiency in one or more methods in systems biology that allows students to independently perform and organise a scientific project in the field of bioinformatics and to document the results obtained. Students are able to design a research project and are prepared for working on a scientific question for their thesis.</p>		
Courses (type, number of weekly contact hours, language — if other than German)		
P + 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)		
<p>Students will be informed about the length and scope of the assessment prior to the course. Usually, one of the following options will be chosen: a) written examination (30 to 60 minutes, including multiple choice questions) or b) log (approx. 10 to 30 pages) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (approx. 30 to 60 minutes) or e) presentation (20 to 45 minutes)</p>		
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		
<p>Master's degree (1 major) Biology (2011) Master's degree (1 major) Biology (2010) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)</p>		

Module title		Abbreviation
Systems Biology B		07-MS-B-121-m01
Module coordinator		Module offered by
holder of the Chair of Bioinformatics		Faculty of Biology
ECTS	Method of grading	Only after succ. compl. of module(s)
5	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Advances and current results of computational systems biology are explained and discussed, this includes results from functional genomics, dynamics of the transcriptome, of metabolism and metabolic networks as well as regulatory networks.		
Intended learning outcomes		
Understand recent results in systems biology. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions of systems biology.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
Students will be informed about the method, length and scope of the assessment prior to the course. a) written examination (30 to 60 minutes, including multiple choice questions) or b) oral examination of one candidate each (30 to 60 minutes) or c) oral examination in groups of up to 3 candidates (30 to 60 minutes)		
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) Biology (2011) Master's degree (1 major) Biology (2014) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Biomedicine (2013) Master's degree (1 major) Biomedicine (2012) Master's degree (1 major) Computational Mathematics (2012)		

Module title		Abbreviation
Advanced Physical Chemistry		o8-PCM1-102-m01
Module coordinator		Module offered by
lecturer of seminar "Laserspektroskopie" (Laser Spectroscopy)		Institute of Physical and Theoretical Chemistry
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>This module introduces students to the fundamental principles of laser spectroscopy. It discusses absorption and emission spectroscopy. In addition, the module gives students the opportunity to use modern experimental methods in physical chemistry in the laboratory. After a safety briefing, the students autonomously conduct experiments in the laboratory. Students will be expected to take tests and write lab reports to demonstrate their knowledge.</p>		
Intended learning outcomes		
<p>Students are able to explain the components and operating principles of lasers as well as the optical principles of laser technology. They are able to describe the principles of absorption and emission spectroscopy. Students have developed a high level of proficiency in modern experimental methods in physical chemistry. They are able to analyse the resulting measurements and write a lab report.</p>		
Courses (type, number of weekly contact hours, language — if other than German)		
<p>This module comprises 2 module components. Information on courses will be listed separately for each module component.</p> <ul style="list-style-type: none"> o8-PCM1-1-102: S + Ü (no information on SWS (weekly contact hours) and course language available) o8-PCM1-2-102: 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)		
<p>Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.</p> <p>Assessment in module component o8-PCM1-1-102: Laser Spectroscopy Laser Spectroscopy</p> <ul style="list-style-type: none"> 5 ECTS, Method of grading: numerical grade written examination (90 minutes) or oral examination (20 minutes) Language of assessment: German or English <p>Assessment in module component o8-PCM1-2-102: Advanced Physical Chemistry (Lab)</p> <ul style="list-style-type: none"> 5 ECTS, Method of grading: (not) successfully completed Vortestate (pre-experiment exams) and Nachtestate (post-experiment exams) (approx. 15 minutes), log (approx. 15 pages) 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) Computational Mathematics (2012)

Module title		Abbreviation
Chemical Dynamics		o8-PCM2-102-m01
Module coordinator		Module offered by
lecturer of seminar "Chemische Dynamik" (Chemical Dynamics)		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 gives students the opportunity to explore advanced topics in chemical kinetics and reaction dynamics in more detail. It discusses methods and models for investigating and describing chemical reactions.		
Intended learning outcomes		
Students are able to discuss advanced topics in chemical kinetics and reaction dynamics. They can describe methods and models for the investigation of chemical reactions.		
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) or oral examination of one candidate each (20 minutes) or talk (30 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) Computational Mathematics (2012)		

Module title		Abbreviation
Nanoscale Materials		o8-PCM3-102-m01
Module coordinator		Module offered by
lecturer of the seminar "Nanoskalige Materialien"		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 discusses advanced topics in nanoscale materials. It focuses on the structure, properties, fabrication, modern characterisation methods and application areas of nanoscale materials.		
Intended learning outcomes		
Students are able to characterise nanoscale materials. They are able to name analytical methods and application areas of nanoscale materials.		
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) or oral examination of one candidate each (20 minutes) or talk (30 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		
Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012) 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) Computational Mathematics (2012) Master's degree (1 major) Functional Materials (2012)		

Module title		Abbreviation
Ultrafast spectroscopy and quantum-control		o8-PCM4-102-m01
Module coordinator		Module offered by
lecturer of the seminar "Ultrakurzzeitspektroskopie and Quantenkontrolle"		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 discusses advanced topics in ultrafast spectroscopy and quantum control. It focuses on ultrashort laser pulses, time-resolved laser spectroscopy and coherent control.		
Intended learning outcomes		
Students are able to describe the generation of ultrashort laser pulses and to characterise them. They can explain the theory of time-resolved laser spectroscopy and name experimental methods. They can describe the principles and applications of quantum control.		
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) or oral examination of one candidate each (20 minutes) or talk (30 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) Computational Mathematics (2012)		

Module title		Abbreviation
Physical chemistry of supramolecular assemblies		o8-PCM5-102-m01
Module coordinator		Module offered by
lecturer of the seminar "Physikalische Chemie Supramolekularer Strukturen"		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 examines the basic interactions between molecules. It discusses the formation and physical-chemical properties of aggregates as well as key applications of supramolecular chemistry.		
Intended learning outcomes		
Students are able to explain the basic interactions between molecules demonstrating a high degree of expertise in the field. They can describe the formation and physical-chemical properties of aggregates. They can name modern applications of supramolecular 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) and/or oral examination of one candidate each (20 minutes) and/or talk (30 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) Mathematics (2012) Master's degree (1 major) Technology of Functional Materials (2010) Master's degree (1 major) Technology of Functional Materials (2009) Master's degree (1 major) Computational Mathematics (2012) Master's degree (1 major) Functional Materials (2012)		

Module title		Abbreviation
Physical Chemistry (Advanced Lab)		o8-PCM6-102-m01
Module coordinator		Module offered by
lecturers Physikalische Chemie (Physical Chemistry)		Institute of Physical and Theoretical Chemistry
ECTS	Method of grading	Only after succ. compl. of module(s)
5	(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 Physical Chemistry and learn some advanced synthesis and analytical methods.		
Intended learning outcomes		
Students have become proficient in the research methods typically used by the relevant physical chemistry research group. They are able to analyse their findings and thus help answer topical questions in physical chemistry.		
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)		
presentation (20 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) Computational Mathematics (2012)		

Module title		Abbreviation
Theoretical Chemistry - Project work		o8-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. <ul style="list-style-type: none"> o8-TCAP-1-102: P (no information on language and number of weekly contact hours available) o8-TCAP-2-102: P (no information on language and number of weekly contact hours available) o8-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.		
<p>Assessment component to module component o8-TCAP-1-102: Theoretische Chemie Arbeitsgruppenpraktikum Wellenpaketdynamik</p> <ul style="list-style-type: none"> 5 ECTS credits, method of grading: (not) successfully completed presentation (approx. 30 minutes) Language of assessment: German or English <p>Assessment component to module component o8-TCAP-2-102: Theoretische Chemie Arbeitsgruppenpraktikum Wellenfunktionsmethoden</p> <ul style="list-style-type: none"> 5 ECTS credits, method of grading: (not) successfully completed presentation (approx. 30 minutes) Language of assessment: German or English <p>Assessment component to module component o8-TCAP-3-102: Theoretische Chemie Arbeitsgruppenpraktikum Dichtefunktionaltheorie</p> <ul style="list-style-type: none"> 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		o8-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		o8-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		o8-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
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		
<p>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.</p>		
Intended learning outcomes		
<p>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.</p>		
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)		
<p>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</p>		
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		
<p>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)</p>		

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		
<p>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.</p>		
Intended learning outcomes		
<p>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.</p>		
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)		
<p>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</p>		
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		
<p>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)</p>		

Module title		Abbreviation
Automata Theory		10-I=AUT-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	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).
Contents		
Finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular languages and star-free languages, two-way automata.		
Intended learning outcomes		
The students possess a fundamental and applicable knowledge in the areas of finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular and star-free languages, two-way automata.		
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) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012) First state examination for the teaching degree Gymnasium Computer Science (2009)		

Module title		Abbreviation
Computability Theory		10-I=BER-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	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).
Contents		
Gödel numbering, computable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.		
Intended learning outcomes		
The students possess a fundamental and applicable knowledge in the areas of Gödel numbers, countable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.		
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) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012) First state examination for the teaching degree Gymnasium Computer Science (2009)		

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
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
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
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
Mathematical Logic		10-I=ML-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	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).
Contents		
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 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. 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) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012) First state examination for the teaching degree Gymnasium Computer Science (2009)		

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
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		
<p>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-holonomie 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.</p>		
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)		
<p>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.</p> <p>Language of assessment: German, English if agreed upon with the examiner</p>		
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		
<p>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)</p>		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 47 / 172

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)		
--		
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
Algorithmic Graph Theory		10-I-AGT-122-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	undergraduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).
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: 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		
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) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Computational Mathematics (2012)		

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		
<p>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.</p>		
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)		
<p>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</p>		
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		
<p>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)</p>		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 53 / 172

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 with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 55 / 172

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

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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)		
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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		
<p>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.</p>		
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)		
<p>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</p>		
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		
<p>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)</p>		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 62 / 172

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		
<p>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.</p> <p>Recommended previous knowledge: Familiarity with the contents of the module "Functional Analysis" is strongly recommended.</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>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)</p>

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
<p>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)</p>

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
<p>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)</p>

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		
<p>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).</p> <p>Recommended previous knowledge: Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended.</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>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)</p>

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 with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 75 / 172

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
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		
<p>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.</p> <p>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.</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>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)</p>

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 continuous 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
<p>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)</p>

Module title		Abbreviation
Stochastic 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 stochastic 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) Econometrics (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
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		
<p>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.</p> <p>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".</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
Allocation of places		
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Additional information		
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Workload		
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Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 89 / 172

Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
<p>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)</p>

Module title		Abbreviation
Learning by Teaching Computational Mathematics		10-M=ELTCM-122-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 applied mathematics 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) Computational Mathematics (2012)		

Module title		Abbreviation
Study Group Mathematics in the Sciences		10-M=GMNW-122-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		
A modern topic in mathematics in the sciences. Recommended previous knowledge: Basic knowledge from the modules "Ordinary Differential Equations" and "Introduction to Partial Differential Equations" is recommended, as well as basic knowledge of functional analysis.		
Intended learning outcomes		
The student gains insight into contemporary research problems in mathematics in the sciences. 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 of 2 candidates (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) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (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
Master Thesis Computational Mathematics		10-M=MACM-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) Computational Mathematics (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 Mathematics in the Sciences		10-M=SMNW-122-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 in the sciences.		
Recommended previous knowledge: Basic knowledge from the modules "Ordinary Differential Equations" and "Introduction to Partial Differential Equations" is recommended, as well as basic knowledge of functional analysis.		
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) 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
Selected Topics in Analysis		10-M=VANA-122-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	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		
<p>In-depth discussion of a specialised topic in analysis taking into account recent developments and interrelations with other mathematical concepts.</p> <p>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.</p>		
Intended learning outcomes		
The student is acquainted with advanced results in a selected topic in analysis, and is able to apply these 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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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) Mathematical Physics (2012)
Master's degree (1 major) Computational Mathematics (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		
<p>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.</p> <p>Recommended previous knowledge: Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Econometrics (2011) Master's degree (1 major) Mathematical Physics (2012) Master's degree (1 major) Computational Mathematics (2012)</p>

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
<p>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)</p>

Module title		Abbreviation
Giovanni-Prodi Lecture Selected Topics (Master)		10-M=VGPC-122-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	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 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 (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: 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) Mathematical Physics (2012)		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 107 / 172

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

Module title		Abbreviation
Mathematical Continuum Mechanics		10-M=VKOM-122-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	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		
<p>Partial differential equations and/or variational methods in the context of continuum mechanics.</p> <p>Recommended previous knowledge: Basic knowledge from the modules "Ordinary Differential Equations" and "Introduction to Partial Differential Equations" is recommended, as well as basic knowledge of functional analysis.</p>		
Intended learning outcomes		
The student masters the mathematical methods in mathematical continuum mechanics 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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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		
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Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 109 / 172

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

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		
<p>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.</p> <p>Recommended previous knowledge: Basic knowledge of functional analysis, such as that taught in the module "Functional Analysis", is recommended.</p>		
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)		
<p>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)</p> <p>Language of assessment: German, English</p>		
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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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
<p>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)</p>

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 Galerkin 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
<p>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)</p>

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 with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 119 / 172

Master's degree (1 major) Mathematics (2010)
Master's degree (1 major) Econometrics (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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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
Astrophysics		11-A4-072-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	undergraduate	Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
History of astronomy, coordinates and time measurement, the solar system, size scales in outer space, telescopes and detectors, stellar structure, stellar atmospheres, stellar evolution, final stages of stellar evolution, interstellar medium, structure of the Milky Way, local universe, expanding space-time, galaxies, active galactic nuclei, large-scale structure of the universe, Friedmann World Models, thermodynamics of the early universe, primordial nucleosynthesis, cosmic microwave background radiation, structure formation, inflation		
Intended learning outcomes		
The students are familiar with the modern world view of Astrophysics. They know methods and tools for astrophysical observations and evaluations. They are able to use these methods to plan and analyse own observations. They know the structure of the universe, e.g. of stars and galaxies and understand the process of their development.		
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)		
written examination (approx. 120 minutes)		
Allocation of places		
Only as part of pool of general key skills (ASQ): 15 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		

Bachelor' degree (1 major) Physics (2007)
 Bachelor' degree (1 major) Physics (2010)
 Bachelor' degree (1 major) Physics (2009)
 Bachelor' degree (1 major) Physics (2012)
 Bachelor' degree (1 major) Physics (2008)
 Bachelor' degree (1 major) Mathematical Physics (2009)
 Bachelor' degree (1 major) Mathematical Physics (2012)
 Bachelor' degree (1 major) Aerospace Computer Science (2011)
 Master's degree (1 major) Mathematics (2012)
 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)
 Bachelor's degree (1 major, 1 minor) Physics (Minor, 2008)
 Bachelor's degree (1 major, 1 minor) Physics (Minor, 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
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		
<ol style="list-style-type: none"> 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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>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)</p>

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		
Master's with 1 major Computational Mathematics (2012)		
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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		
Master's with 1 major Computational Mathematics (2012)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012		page 137 / 172

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
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		
Master's with 1 major Computational Mathematics (2012)		
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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 Lasers - Principles and Current Research		11-HLF-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		
<p>This lecture discusses the principles of laser physics, based on the example of semiconductor lasers, and current developments regarding components. The principles of lasers are described on the basis of a general laser model, which will then be extended to special aspects of semiconductor lasers. Basic concepts such as threshold condition, characteristic curve and laser efficiency are derived from coupled rate equations for charge carriers and photons. Other topics of the lecture are optical processes in semiconductors, layer and ridge waveguides, laser resonators, mode selection, dynamic properties as well as technology for the generation of semiconductor lasers. The lecture closes with current topics of laser research such as quantum dot lasers, quantum cascade lasers, terahertz lasers or high-performance lasers.</p>		
Intended learning outcomes		
<p>The students have advanced knowledge of the principles of semiconductor-laser physics. They can apply their knowledge to modern questions and know the applications in the current development of components.</p>		
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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
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
<p>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) 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) Master's degree (1 major) Functional Materials (2012)</p>

Module title		Abbreviation
Semiconductor Physics		11-HLP-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		
Advanced examination of crystal bonding and the electronic band structure of semiconductors. Optical excitations and their coupling effects. Electron-phonon coupling. Temperature-dependent transport properties. Quantisation effects of semiconductors with reduced dimensions. (Semi-)magnetic semiconductors.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of Semiconductor Physics. They know the physical principles of semiconductors and have gained an overview of the important characteristics of semiconductor materials.		
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) 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)
 Master's degree (1 major) Functional Materials (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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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
<p>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)</p>

Module title		Abbreviation
Computational Astrophysics		11-NMA-111-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 + 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. 120 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 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 (2012)
 Bachelor' degree (1 major) Mathematical Physics (2012)
 Master's degree (1 major) Mathematics (2012)
 Master's degree (1 major) Physics (2011)
 Master's degree (1 major) Mathematical Physics (2012)
 Master's degree (1 major) FOKUS Physics (2011)
 Master's degree (1 major) Computational Mathematics (2012)

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		
<p>"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:</p> <ol style="list-style-type: none"> 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, Lorentz 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)		
<p>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)</p> <p>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.</p> <p>Language of assessment: German, English</p>		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 149 / 172

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
<p>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)</p>

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
<p>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)</p>

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)		
Master's with 1 major Computational Mathematics (2012)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2012	page 157 / 172

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
Semiconductor Physics and Devices		11-SPD-102-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		
Principles of Semiconductor Physics. Introduction to key theories on semiconductors. Components from the areas of electronics and photonics.		
Intended learning outcomes		
The students are familiar with the properties of semiconductors, they have gained an overview of the electronic and phononic band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport and are able to apply Poisson, Boltzmann and continuity equations to the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the methods of planar technology and current developments in this sector, they have a basic understanding of component production. They understand the structure and function of the main components of electronics (diodes, transistor, FET, thyristor, diac, triac), microwave applications (tunnel, impatt, baritt and Gunn diode) and 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 importance. They are familiar with current developments in the field of components.		
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)		
written examination (approx. 90 minutes) or 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 project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or 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
<p>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) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) Computational Mathematics (2012) Master's degree (1 major) Functional Materials (2012)</p>

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 chromodynamics. 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)		
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 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 phenomenon 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)		
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)