

# Subdivided Module Catalogue for the Subject **Physics**

as a Master's with 1 major  
with the degree "Master of Science"  
(120 ECTS credits)

Examination regulations version: 2010  
Responsible: Faculty of Physics and Astronomy

## Course of Studies - Contents and Objectives

The Master of Science programme prepares the students for their later scientific work in the field of experimental or theoretical physics. Qualified graduates may pursue doctoral work (degree Dr. rer. nat.) at doctorate-granting institutions. The objective of the education is to impart deepened knowledge of physical principles and of scientific working in research and applied physics. By training physical and analytical thinking skills the students are enabled to use their knowledge self-consistently and to transfer it to new challenges. Completing their Master thesis the graduates demonstrate their ability to solve an experimental or theoretical assignment within limited time using known scientific methods.

## 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:

**ASPO2007**

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

**21-Sep-2010 (2010-59)**

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
<b>Compulsory Courses (40 ECTS credits)</b>				
11-OSP-072-m01	Advanced Seminar Experimental/Theoretical Physics	4	NUM	178
11-PFM-072-m01	Advanced Practical Course Master	6	B/NB	179
11-FS-P-072-m01	Professional Specialization Physics	15	NUM	133
11-MP-P-072-m01	Scientific Methods and Project Management Physics	15	NUM	161
<b>Compulsory Electives (50 ECTS credits)</b>				
The area of mandatory electives (50 ECTS credits) comprises: mandatory electives area SP ("Spezialausbildung Physik" ("Special Training Physics")): 40 ECTS credits, mandatory electives area NP ("Nebenfächer Physik" ("Minors Physics")): 10 ECTS credits. Within the area SP, modules are grouped together by subject. Students may select modules worth a maximum of 40 ECTS credits from one of these module groups. Students also have the option to select modules from different module groups and worth different numbers of credits (total number of credits achieved must be 40). The Faculty will specify whether a specific module belongs to group "Theoretische Physik" ("Theoretical Physics") or group "Experimentelle Physik" ("Experimental Physics") (for the purpose of calculating the overall grade).				
<b>Compulsory Electives Specialisation Physics (40 ECTS credits)</b>				
<b>Applied Physics and Metrology (40 ECTS credits)</b>				
11-MOE-092-m01	Opto-electronic Material Properties	5	NUM	159
11-OHL-092-m01	Organic Semiconductor	5	NUM	176
11-A2-081-m01	Electronics	6	NUM	61
11-ASL-092-m01	Reproducing Sensors in Infrared	3	NUM	74
11-ASL-092-m01	Applied Superconduction	6	NUM	76
11-EBV-092-m01	Principles of Image Processing	3	NUM	106
11-ENT-092-m01	Principles of Energy Technologies	6	NUM	110
11-EPP-092-m01	Introduction to Plasmaphysics	6	NUM	112
11-HLF-092-m01	Semiconductor Lasers - Principles and Current Research	6	NUM	138
11-KVM-092-m01	Principles of Classification of Patterns	3	NUM	146
11-LVW-092-m01	Introduction to LabVIEW	6	NUM	152
11-TDO-092-m01	Thermodynamics and Economics	6	NUM	235
11-ZDR-111-m01	Principles of two- and threedimensional Röntgen imaging	6	NUM	257
11-TDOE-141-m01	Thermodynamics and Economics	3	B/NB	237
11-BSV-122-m01	Image and Signal Processing in Physics	6	NUM	93
11-BMS-121-m01	Imaging Methods at the Synchrotron	4	NUM	87
11-BMS-131-m01	Imaging Methods at the Synchrotron	4	NUM	89
11-BSV-131-m01	Image and Signal Processing in Physics	6	NUM	95
11-QUI-132-m01	Quantum Information Technology	6	NUM	194
<b>Solid State Physics and Nanostructures (40 ECTS credits)</b>				
11-MOE-092-m01	Opto-electronic Material Properties	5	NUM	159
11-CRP-131-m01	Critical Phenomena	6	NUM	101
11-ASL-092-m01	Applied Superconduction	6	NUM	76
11-HLF-092-m01	Semiconductor Lasers - Principles and Current Research	6	NUM	138
11-AHL-092-m01	Applied Semiconductor Physics	6	NUM	64
11-FK2-092-m01	Solid State Physics 2	8	NUM	125
11-FKS-092-m01	Solid State Spectroscopy	6	NUM	127
11-FKT-092-m01	Transport Phenomena in Solids	6	NUM	130
11-HLP-092-m01	Semiconductor Physics	6	NUM	140
11-HNS-092-m01	Semiconductor Nanostructures	6	NUM	142
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 4 / 258



11-LHQ-092-m01	Lithography in Semiconductor Technology and Theory of Quantum Transport	6	NUM	148
11-MAG-092-m01	Magnetism	6	NUM	154
11-MST-092-m01	Magnetism and Spin Transport	6	NUM	164
11-NAN-092-m01	Nanoanalytics	6	NUM	166
11-NDS-092-m01	Low-Dimensional Structures	4	NUM	168
11-NEL-092-m01	Nanoelectronics	6	NUM	170
11-NOP-092-m01	Nano-Optics	4	NUM	174
11-QM2-092-m01	Quantum Mechanics II	8	NUM	188
11-QPM-092-m01	Quantum Phenomena in electronic correlated Materials	6	NUM	190
11-QVTP-092-m01	Many Body Quantum Theory	8	NUM	195
11-RMS-092-m01	Relativistic Effects in Mesoscopic Systems	5	NUM	199
11-TFK-092-m01	Theoretical Solid State Physics	8	NUM	241
11-TSL-092-m01	Theory of Superconduction	5	NUM	251
11-RMFT-102-m01	Renormalization Group Methods in Field Theory	6	NUM	197
11-SPI-102-m01	Spintronics	6	NUM	229
11-MSS-102-m01	Methods in Surface Spectroscopy	4	NUM	162
11-EEW-102-m01	Electron Electron Interaction	4	NUM	108
11-TFK2-111-m01	Theoretical Solid State Physics 2	8	NUM	243
11-IEM-111-m01	Introduction to Electron Microscopy	4	NUM	144
11-FTFK-112-m01	Field Theory in Solid State Physics	8	NUM	134
11-DFT-142-m01	Density Functional Theory and the Physics of Oxide Heterostructure	4	NUM	103
11-CMS-122-m01	Computational Materials Science	8	NUM	97
11-CMS-131-m01	Computational Materials Science	8	NUM	99
11-UGS-131-m01	Disordered Systems	4	NUM	253
11-FKS2-132-m01	Solid State Spectroscopy 2	6	NUM	129
11-PMM-132-m01	Physics of Advanced Materials	6	NUM	183
11-TOPO-132-m01	Topological Order	6	NUM	246
11-TFP-132-m01	Topology in Solid State Physics	6	NUM	245
<b>Astrophysics and Particle Physics (40 ECTS credits)</b>				
11-A4-072-m01	Astrophysics	6	NUM	62
11-ASM-131-m01	Astronomical Methods	6	NUM	78
11-EPP-092-m01	Introduction to Plasmaphysics	6	NUM	112
11-AKM-092-m01	Cosmology	6	NUM	66
11-APL-092-m01	Plasma-Astrophysics	6	NUM	68
11-ASP-092-m01	Introduction to Space Physics	6	NUM	80
11-AWP-092-m01	Atmosphere and Space Physics	6	NUM	85
11-GRT-092-m01	Group Theory	6	NUM	136
11-NMA-092-m01	Numerical Methods in Astrophysics	6	NUM	172
11-QFT2-092-m01	Quantum Field Theory II	6	NUM	184
11-RNT-092-m01	Renormalization Theory	6	NUM	201
11-RQFT-092-m01	Relativistical Quantumfield Theory	8	NUM	203
11-RTT-092-m01	Theory of Relativity	6	NUM	205
11-TEP-092-m01	Theoretical Elementary Particle Physics	8	NUM	239
11-TPE-092-m01	Experimental Particle Physics	4	NUM	247
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 5 / 258

11-TPS-092-m01	Particle Physics (Standard Model)	8	NUM	249
11-SUS-092-m01	Supersymmetry I and II	6	NUM	233
11-AST-092-m01	Theoretical Astrophysics	6	NUM	82
11-WWB-102-m01	Strong Interaction in Accelerator Experiments	3	NUM	255
11-APP-111-m01	Practical Course Astrophysics	6	B/NB	70
11-DTS-111-m01	Particle Radiation Detectors	4	NUM	104
11-MAS-111-m01	Modern Astrophysics	4	NUM	157
11-ETT-111-m01	Introduction to Elementary Particle Theory	4	NUM	114
11-QSG-102-m01	Quantum Loop Gravity	4	NUM	192
11-ATT-111-m01	Concepts of Theoretical Astroparticle physics	4	NUM	83
11-ART-112-m01	General Theory of Relativity	4	NUM	72
11-SRT-112-m01	Special Theory of Relativity	4	NUM	231
<b>Complex Systems, Quantum Control and Biophysics (40 ECTS credits)</b>				
11-NOP-092-m01	Nano-Optics	4	NUM	174
11-BMT-092-m01	Biophysical Measurement Technology in Medical Science	6	NUM	91
11-LMB-092-m01	Laboratory and Measurement Technology in Biophysics	6	NUM	150
11-PKS-092-m01	Physics of Complex Systems	6	NUM	181
11-QIC-092-m01	Quantum Information and Quantum Computing	5	NUM	186
11-SDC-092-m01	Statistics, Data Analysis and Computer Physics	4	NUM	207
<b>Other Modules Specialisation (40 ECTS credits)</b>				
11-SF-4A-072-m01	Module Type 4A Special Training Astronomy	4	NUM	209
11-SF-4D-072-m01	Module Type 4D Special Training Didactics	4	NUM	210
11-SF-4E-072-m01	Module Type 4E Special Training Experimental Physics	4	NUM	211
11-SF-4I-072-m01	Module Type 4I Special Training Interdisciplinary Research Fields	4	NUM	212
11-SF-4T-072-m01	Module Type 4T Special Training Theoretical Physics	4	NUM	213
11-SF-5A-072-m01	Module Type 5A Special Training Astronomy	5	NUM	214
11-SF-5D-072-m01	Module Type 5D Special Training Didactics	5	NUM	215
11-SF-5E-072-m01	Module Type 5E Special Training Experimental Physics	5	NUM	216
11-SF-5I-072-m01	Module Type 5I Special Training Interdisciplinary Research Fields	5	NUM	217
11-SF-5T-072-m01	Module Type 5T Special Training Theoretical Physics	5	NUM	218
11-SF-6A-072-m01	Module Type 6A Special Training Astronomy	6	NUM	219
11-SF-6D-072-m01	Module Type 6D Special Training Didactics	6	NUM	220
11-SF-6E-072-m01	Module Type 6E Special Training Experimental Physics	6	NUM	221
11-SF-6I-072-m01	Module Type 6I Special Training Interdisciplinary Research Fields	6	NUM	222
11-SF-6T-072-m01	Module Type 6T Special Training Theoretical Physics	6	NUM	223
11-SF-8A-072-m01	Module Type 8A Special Training Astronomy	8	NUM	224
11-SF-8D-072-m01	Module Type 8D Special Training Didactics	8	NUM	225
11-SF-8E-072-m01	Module Type 8E Special Training Experimental Physics	8	NUM	226
11-SF-8I-072-m01	Module Type 8I Special Training Interdisciplinary Research Fields	8	NUM	227
11-SF-8T-072-m01	Module Type 8T Special Training Theoretical Physics	8	NUM	228
11-FPA-112-m01	Visiting Research Project	10	NUM	132
11-EXE5-111-m01	Current Topics in Experimental Physics	5	NUM	116

11-EXE6-111-m01	Current Topics in Experimental Physics	6	NUM	117
11-EXE7-111-m01	Current Topics in Experimental Physics	7	NUM	118
11-EXE8-111-m01	Current Topics in Experimental Physics	8	NUM	119
11-EXT5-111-m01	Current Topics in Theoretical Physics	5	NUM	121
11-EXT6-111-m01	Current Topics in Theoretical Physics	6	NUM	122
11-EXT7-111-m01	Current Topics in Theoretical Physics	7	NUM	123
11-EXT8-111-m01	Current Topics in Theoretical Physics	8	NUM	124
<b>Compulsory Electives Subsidiary Subjects Physics (10 ECTS credits)</b>				
o8-SAM-o92-m01	Technology of Sensor and Actor Materials including Smart Fluids	5	NUM	13
o8-EEW-101-m01	Electrochemical Energy Storage and Conversion	5	NUM	10
10-M-NM1-o82-m01	Numerical Mathematics 1	8	NUM	53
10-M-NM2-o82-m01	Numerical Mathematics 2	5	NUM	55
10-M-PRG-o82-m01	Programming course for students of Mathematics and other subjects	3	B/NB	57
10-M-COM-o82-m01	Computeroriented Mathematics	3	B/NB	51
10-M-VAN-o82-m01	Advanced Analysis	8	NUM	59
o8-CP1-o72-m01	General Chemistry for Physics and Engineers	10	NUM	8
10-I-EIN-o72-m01	Introduction to Computer Science for Students of all Faculties	10	NUM	23
11-EXNP6-112-m01	Non-Physical Minor Subject	6	NUM	120
10-I-DB-102-m01	Databases	5	NUM	21
10-I-OOP-102-m01	Object-oriented Programming	5	NUM	24
10-I-AR-102-m01	Automation and Control Technology	8	NUM	18
10-I-BS-102-m01	Operating Systems	5	NUM	20
10-I-RAK-102-m01	Computer Architecture	5	NUM	25
10-I=PVS-102-m01	Programming of Distributed Systems	8	NUM	17
10-I=KI-102-m01	Artificial Intelligence	8	NUM	15
10-I=DB2-102-m01	Databases II	5	NUM	14
10-I=PA-102-m01	Program Design and Analysis	5	NUM	16
10-M=AAAN-102-m01	Applied Analysis	10	NUM	27
10-M=ADGM-102-m01	Differential Geometry	10	NUM	29
10-M=AFTH-102-m01	Complex Analysis	10	NUM	31
10-M=ALTH-102-m01	Lie Theory	10	NUM	33
10-M=ATOP-102-m01	Topology	10	NUM	35
10-M=AZTH-102-m01	Number Theory	10	NUM	37
10-M=VGDS-102-m01	Groups and their Representations	10	NUM	41
10-M=VGEM-102-m01	Geometrical Mechanics	10	NUM	43
10-M=VNPE-102-m01	Numeric of Partial Differential Equations	10	NUM	47
10-M=VDIM-102-m01	Discrete Mathematic	5	NUM	39
10-M=VMPPH-102-m01	Selected Topics in Mathematical Physics	5	NUM	45
10-M=VQKC-102-m01	Quantum Control and Quantum Computing	5	NUM	49
o8-PCM4-PHY-111-m01	Ultrafast Spectroscopy and Quantum Control	5	NUM	12
o8-MW-PHY-111-m01	Structure and Properties of Modern Materials: Experiments and Simulations	5	NUM	11
<b>Thesis (30 ECTS credits)</b>				
11-MA-P-o72-m01	Master Thesis Physics	30	NUM	156
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 7 / 258

Module title			Abbreviation
General Chemistry for Physics and Engineers			o8-CP1-072-mo1
Module coordinator		Module offered by	
lecturer of the course		Institute of Inorganic Chemistry	
ECTS	Method of grading	Only after succ. compl. of module(s)	
10	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	undergraduate	--	
Contents			
This module discusses the fundamental principles of both inorganic and organic chemistry. The lab course gives students the opportunity to learn essential methods and perform simple experiments.			
Intended learning outcomes			
Students are able to explain the principles of the periodic table and to extract information from it. They are able to explain basic models of the structure of matter. They have developed the ability to use the language of chemical formulas to describe chemical reactions and to interpret them by identifying the type of reaction. They are able to identify fundamental problems in chemistry and perform experiments to solve them.			
Courses (type, number of weekly contact hours, language — if other than German)			
This module comprises 3 module components. Information on courses will be listed separately for each module component. <ul style="list-style-type: none"><li>o8-IOC-1-072: V (no information on SWS (weekly contact hours) and course language available)</li><li>o8-CP1-1-072: V (no information on SWS (weekly contact hours) and course language available)</li><li>o8-CP1-3-072: P (no information on SWS (weekly contact hours) and course language available)</li></ul>			
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)			
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.			
<b>Assessment in module component o8-IOC-1-072:</b> Organic Chemistry for students of medicine, biomedicine, dental medicine, engineering and natural science <ul style="list-style-type: none"><li>3 ECTS, Method of grading: numerical grade</li><li>written examination (approx. 60 minutes)</li></ul>			
<b>Assessment in module component o8-CP1-1-072:</b> Basics of General and Inorganic Chemistry <ul style="list-style-type: none"><li>5 ECTS, Method of grading: numerical grade</li><li>written examination (60 minutes)</li></ul>			
<b>Assessment in module component o8-CP1-3-072:</b> General and Analytical Chemistry (lab) <ul style="list-style-type: none"><li>2 ECTS, Method of grading: (not) successfully completed</li><li>for each experiment: Vortestate (pre-experiment exams, approx. 10 minutes each), assessment of practical performance (log, 2 to 5 pages), Nachtestate (post-experiment exams, approx. 10 minutes each)</li><li>Assessment offered: once a year, summer semester</li><li>Only after successful completion of module components: Successful completion of module component o8-CP1-1 is a prerequisite for participation in module component o8-CP1-3.</li></ul>			
Allocation of places			
--			
Additional information			
--			
Workload			
--			

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
Bachelor' degree (1 major) Physics (2007) Bachelor' degree (1 major) Physics (2009) Bachelor' degree (1 major) Physics (2008) Bachelor' degree (1 major) Nanostructure Technology (2008) Bachelor' degree (1 major) Nanostructure Technology (2007) Master's degree (1 major) Physics (2010) No final examination Special study offering (2010)

Module title		Abbreviation
Electrochemical Energy Storage and Conversion		o8-EEW-101-m01
Module coordinator		Module offered by
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Chemistry and application of: battery systems (aqueous and non-aqueous systems such as lead, nickel cadmium and nickel metal hydride, sodium sulphur, sodium nickel chloride, lithium ion accumulators), electrochemical double layer capacitors, redox-flow batteries, fuel cell systems (AFC, PEMFC, DMFC, PAFC, SOFC), solar cells (Si, CIS, CIGS, GaAs, organic and dye solar cell), thermoelectric devices.		
Intended learning outcomes		
Students have developed a knowledge of electrochemical energy storage and conversion and are able to apply that knowledge to research problems.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + P + E (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 lab report (approx. 5 pages)		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Nanostructure Technology (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)		

Module title			Abbreviation
Structure and Properties of Modern Materials: Experiments and Simulations			o8-MW-PHY-111-mo1
Module coordinator		Module offered by	
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis	
ECTS	Method of grading	Only after succ. compl. of module(s)	
5	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	graduate	--	
Contents			
Material properties of metals and ceramics: correlation of structure/property relations through experiments and simulations.			
Intended learning outcomes			
Students gain an insight into the properties of modern materials: aerospace aluminium alloys and high-performance ceramics. They are introduced to measuring methods and calculation methods using numerical simulation. A special focus is on the relation between the micro/nanoscope structure of materials and the resulting properties.			
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. 45 minutes)			
Allocation of places			
--			
Additional information			
--			
Workload			
--			
Teaching cycle			
--			
Referred to in LPO I (examination regulations for teaching-degree programmes)			
--			
Module appears in			
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)			



Module title		Abbreviation
Ultrafast Spectroscopy and Quantum Control		o8-PCM4-PHY-111-m01
Module coordinator		Module offered by
lecturer of the seminar "Ultrakurzzeitspektroskopie und 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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 (2010) Master's degree (1 major) FOKUS Physics (2011)		



Module title		Abbreviation
Technology of Sensor and Actor Materials including Smart Fluids		o8-SAM-092-m01
Module coordinator		Module offered by
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Fabrication, effects and applications of sensory and actuator materials such as piezoelectrics, shape memory materials and magnetostrictive materials. Electrorheological and magnetorheological fluids, magnetofluids.		
<b>Intended learning outcomes</b>		
Students have developed fundamental knowledge in the area of sensory and actuator materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + P (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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) Technology of Functional Materials (2009) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010)		

Module title		Abbreviation
<b>Databases II</b>		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).
<b>Contents</b>		
Data warehouses and data mining; XML databases; web databases; introduction to Datalog.		
<b>Intended learning outcomes</b>		
The students have advanced knowledge about relational databases, XML and data mining.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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
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).
<b>Contents</b>		
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.		
<b>Intended learning outcomes</b>		
The students possess theoretical and practical knowledge about artificial intelligence and are able to assess possibilities for its application.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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
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).
<b>Contents</b>		
Program analysis, model creation in software engineering, program quality, test of programs, process models.		
<b>Intended learning outcomes</b>		
The students are able to analyse programs, to use testing frameworks and metrics as well as to judge program quality.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Computer Science (2010) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Business Information Systems (2011) Master's degree (1 major) Business Information Systems (2013) Master's degree (1 major) Computational Mathematics (2012) First state examination for the teaching degree Gymnasium Computer Science (2009)		

Module title		Abbreviation
Programming of Distributed Systems		10-I=PVS-102-m01
Module coordinator		Module offered by
holder of the Chair of Computer Science II		Institute of Computer Science
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e. g. completion of exercises).
<b>Contents</b>		
Design and development of parallelly and distributedly executed programs.		
<b>Intended learning outcomes</b>		
The students possess the methodic knowledge and practical skills for the design and development of parallelly and distributedly running programs.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Computer Science (2010) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) First state examination for the teaching degree Gymnasium Computer Science (2009)		

Module title		Abbreviation
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).
<b>Contents</b>		
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.		
<b>Intended learning outcomes</b>		
The students master the fundamentals of automation and control.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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 with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 18 / 258

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
Operating Systems		10-I-BS-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	undergraduate	Admission prerequisite to assessment: exercises (type and scope to be announced by the lecturer at the beginning of the course).
<b>Contents</b>		
Batch, time sharing, real-time virtual machines, system calls, processes and threads, cooperating processes, schedulers, process synchronisation, semaphores, monitors, critical regions, deadlocks, dynamic memory management, segmentation, paging, file systems, interfaces, directory structure, network file systems, hard drive organisation, basics of MS operating systems.		
<b>Intended learning outcomes</b>		
The students possess knowledge and practical skills in building and using essential parts of operating systems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 69 (1) 1. c) Informatik Technische Informatik		
<b>Module appears in</b>		
Bachelor' degree (1 major) Computer Science (2010) Bachelor' degree (1 major) Aerospace Computer Science (2009) Bachelor' degree (1 major) Aerospace Computer Science (2011) Master's degree (1 major) Computer Science (2010) Master's degree (1 major) 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)		



Module title		Abbreviation
<b>Databases</b>		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).
<b>Contents</b>		
Relational algebra and complex SQL statements; database planning and normal forms; transaction management.		
<b>Intended learning outcomes</b>		
The students possess knowledge about database modelling and queries in SQL as well as transactions.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 49 (1) 1. b) Datenbanksysteme und Softwaretechnologie § 69 (1) 1. b) Datenbanksysteme und Softwaretechnologie		
<b>Module appears in</b>		
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 Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 21 / 258

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
Introduction to Computer Science for Students of all Faculties		10-I-EIN-072-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)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	Admission prerequisite to assessment: academic requirements to be met in exercises as specified at the beginning of the course.
<b>Contents</b>		
Foundations of computer science including representation of information and websites (HTML, XML, EBNF), databases, algorithms and data structures, programming (Java).		
<b>Intended learning outcomes</b>		
The students are familiar with the fundamentals of computer science, e. g. in the areas of representation of information and websites (HTML, XML, EBNF), databases, algorithms and data structures, programming in Java.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 (approx. 20 minutes) or c) oral examination in groups (groups of 2: 30 minutes, groups of 3: 40 minutes)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Bachelor' degree (1 major) Geography (2007) Bachelor' degree (1 major) Geography (2008) Bachelor' degree (1 major) Geography (2010) 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) Nanostructure Technology (2010) Master's degree (1 major) Physics (2010) Bachelor's degree (1 major, 1 minor) Digital Humanities (Minor, 2009) Bachelor's degree (2 majors) Digital Humanities (2009)		

Module title		Abbreviation
<b>Object-oriented Programming</b>		10-I-OOP-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).
<b>Contents</b>		
Polymorphism, generic programming, meta programming, web programming, templates, document management.		
<b>Intended learning outcomes</b>		
The students are proficient in the different paradigms of object-oriented programming and have experience in their practical use.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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) Master's degree (1 major) Computer Science (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 with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010
		page 24 / 258

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).
<b>Contents</b>		
Instruction set architectures, command processing through pipelining, statical and dynamic instruction scheduling, caches, vector processors, multi-core processors.		
<b>Intended learning outcomes</b>		
The students master the most important techniques to design fast computers as well as their interaction with compilers and operating systems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 69 (1) 1. c) Informatik Technische Informatik		
<b>Module appears in</b>		
Bachelor' degree (1 major) Computer Science (2010) Bachelor' degree (1 major) Mathematics (2012) Bachelor' degree (1 major) Mathematics (2013) Bachelor' degree (1 major) Computational Mathematics (2012) Bachelor' degree (1 major) Computational Mathematics (2013) Bachelor' degree (1 major) Aerospace Computer Science (2009) Bachelor' degree (1 major) Aerospace Computer Science (2011) Master's degree (1 major) Computer Science (2010) Master's degree (1 major) Mathematics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 25 / 258

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

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		
--		
Additional information		
--		
Workload		
--		
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010
		page 27 / 258

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



Module title		Abbreviation
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		
<p>Central and advanced results in differential geometry, in particular about differentiable and Riemannian manifolds.</p> <p>Recommended previous knowledge: Basic knowledge from the modules "Introduction to Differential Geometry", "Introduction to Topology" and "Geometric Analysis" is recommended.</p>		
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)		
<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		
--		
Additional information		
--		
Workload		
--		

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

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

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

Module title		Abbreviation
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		
--		
Additional information		
--		
Workload		
--		
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010
		page 33 / 258

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

**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		
--		
Additional information		
--		
Workload		
--		
Master's with 1 major Physics (2010)		<p>JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010</p>
		page 37 / 258

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
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
Discrete Mathematic		10-M=VDIM-102-m01
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Advanced methods and results in a selected field of discrete mathematics (e. g. coding theory, cryptography, graph theory or combinatorics)		
Recommended previous knowledge: Basic knowledge of the contents of the module "Introduction to Discrete Mathematics" is required.		
Intended learning outcomes		
The student is acquainted with advanced results in a selected topic in discrete mathematics.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes) Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

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

Module title		Abbreviation
<b>Groups and their Representations</b>		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		
--		
Additional information		
--		
Workload		
--		

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

Module title		Abbreviation
<b>Geometrical Mechanics</b>		10-M=VGEM-102-m01
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
<p>Introduction to geometric mechanics: basic notions of differential geometry and symplectic geometry, Euler-Lagrange equations, Hamiltonian mechanics on manifolds.</p> <p>Recommended previous knowledge: Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the module "Introduction to Topology" is also recommended. Knowledge of theoretical mechanics can also be useful.</p>		
Intended learning outcomes		
The student is able to apply fundamental methods and concepts of geometry to problems in mechanics, and knows about the interrelation of these fields.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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		
--		
Additional information		
--		
Workload		
--		

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



Module title		Abbreviation
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		
<p>Selected topics in mathematical physics (e. g. differential equations of mathematical physics, probability theory, hydrodynamics, hyperbolic conservation equations, mathematical materials science, quantum mechanics).</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 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)		
<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		
--		
Additional information		
--		
Workload		
--		

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

Module title		Abbreviation
Numeric of 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		
--		
Additional information		
--		
Workload		
--		

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

Module title		Abbreviation
Quantum Control and Quantum Computing		10-M=VQKC-102-m01
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e. g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Basics in dynamics of quantum-mechanical systems (e. g. density operators, observables, Schrödinger equation, Liouville-von-Neumann equation), bilinear control systems in quantum mechanics (e. g. finite-dimensional spin systems and/or infinite-dimensional Schrödinger equations with external control), applications (e. g. in quantum computing or magnetic resonance spectroscopy).		
Intended learning outcomes		
The student is acquainted with advanced methods in quantum-mechanical control systems. He gains the ability to work on contemporary research questions in and applications of control systems in quantum mechanics.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
At the beginning of the course, the lecturer will choose one of the following methods of assessment: a) written examination (60 to 90 minutes), b) oral examination of one candidate each (approx. 15 minutes), c) oral examination in groups (groups of 2, approx. 20 minutes) Assessment offered: Assessment offered in the semester in which the course is offered and in the subsequent semester, course offered on demand or every four semesters. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

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

Module title		Abbreviation
<b>Computeroriented Mathematics</b>		10-M-COM-o82-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)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	Admission prerequisite to assessment: regular attendance of exercises (attendance monitored, a maximum of one incident of unexcused absence).
<b>Contents</b>		
Introduction to modern mathematical software for symbolic computation (e. g. Mathematica or Maple) and numerical computation (e. g. Matlab) to supplement the basic modules in analysis and linear algebra ((10-M-ANA or 10-M-ANL) and 10-M-LNA). Computer-based solution of problems in linear algebra, geometry, analysis, in particular differential and integral calculus; visualisation of functions.		
<b>Intended learning outcomes</b>		
The student learns the use of advanced modern mathematical software packages, and is able to assess their fields of application to solve mathematical problems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
project in the form of programming exercises (as specified at the beginning of the course) Assessment offered: once a year, summer semester Language of assessment: German, English if agreed upon with the examiner		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 73 (1) 5. Mathematik Angewandte Mathematik		
<b>Module appears in</b>		
Bachelor' degree (1 major) Computer Science (2010) Bachelor' degree (1 major) Mathematics (2008) 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) Technology of Functional Materials (2009) Bachelor' degree (1 major) Technology of Functional Materials (2010) Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Economathematics (2009) Bachelor' degree (1 major) Economathematics (2008)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 51 / 258

Bachelor' degree (1 major) Mathematical Physics (2009)  
 Bachelor' degree (1 major) Computational Mathematics (2009)  
 Master's degree (1 major) Physics (2010)  
 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) Functional Materials (2012)  
 Bachelor's degree (1 major, 1 minor) Mathematics (Minor, 2008)  
 First state examination for the teaching degree Gymnasium Mathematics (2009)



Module title		Abbreviation
Numerical Mathematics 1		10-M-NM1-082-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)
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.
<b>Contents</b>		
Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration.		
<b>Intended learning outcomes</b>		
The student is acquainted with the fundamental concepts and methods in numerical mathematics, applies them to practical problems and knows about their typical fields of application.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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); 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) Language of assessment: German, English if agreed upon with the examiner		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 73 (1) 5. Mathematik Angewandte Mathematik		
<b>Module appears in</b>		
Bachelor' degree (1 major) Computer Science (2010) Bachelor' degree (1 major) Mathematics (2008) Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2009)		
Master's with 1 major Physics (2010)		page 53 / 258

Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Physics (2008)  
 Bachelor' degree (1 major) Technology of Functional Materials (2009)  
 Bachelor' degree (1 major) Technology of Functional Materials (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Economathematics (2009)  
 Bachelor' degree (1 major) Economathematics (2008)  
 Bachelor' degree (1 major) Mathematical Physics (2009)  
 Bachelor' degree (1 major) Computational Mathematics (2009)  
 Bachelor' degree (1 major) Aerospace Computer Science (2009)  
 Bachelor' degree (1 major) Aerospace Computer Science (2011)  
 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) Technology of Functional Materials (2009)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) Functional Materials (2012)  
 Bachelor's degree (1 major, 1 minor) Mathematics (Minor, 2008)  
 First state examination for the teaching degree Gymnasium Mathematics (2009)

Module title		Abbreviation
Numerical Mathematics 2		10-M-NM2-o82-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	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		
Solution methods and applications for eigenvalue problems, linear programming, initial value problems for ordinary differential equations, boundary value problems.		
Intended learning outcomes		
The student is able to draw a distinction between the different concepts of numerical mathematics and knows about their advantages and limitations concerning the possibilities of application in different fields of natural and engineering sciences and economics.		
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 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) Language of assessment: German, English if agreed upon with the examiner		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
§ 73 (1) 5. Mathematik Angewandte Mathematik		
Module appears in		
Bachelor' degree (1 major) Mathematics (2008) Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2009)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 55 / 258

Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Physics (2008)  
 Bachelor' degree (1 major) Technology of Functional Materials (2009)  
 Bachelor' degree (1 major) Technology of Functional Materials (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Economathematics (2009)  
 Bachelor' degree (1 major) Economathematics (2008)  
 Bachelor' degree (1 major) Mathematical Physics (2009)  
 Bachelor' degree (1 major) Computational Mathematics (2009)  
 Bachelor' degree (1 major) Aerospace Computer Science (2009)  
 Bachelor' degree (1 major) Aerospace Computer Science (2011)  
 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) Technology of Functional Materials (2009)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) Functional Materials (2012)  
 Bachelor's degree (1 major, 1 minor) Mathematics (Minor, 2008)  
 First state examination for the teaching degree Gymnasium Mathematics (2009)

Module title		Abbreviation
Programming course for students of Mathematics and other subjects		10-M-PRG-o82-mo1
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	Admission prerequisite to assessment: regular attendance (attendance monitored, a maximum of one incident of unexcused absence).
<b>Contents</b>		
Basics of a modern programming language (e. g. C or Fortran) taking into account the particular needs in mathematics.		
<b>Intended learning outcomes</b>		
The student is able to work independently on small programming exercises and standard programming problems in mathematics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
P (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
project in the form of programming exercises (as specified at the beginning of the course) Language of assessment: German, English if agreed upon with the examiner		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 73 (1) 5. Mathematik Angewandte Mathematik		
<b>Module appears in</b>		
Bachelor' degree (1 major) Mathematics (2008) 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) Technology of Functional Materials (2009) Bachelor' degree (1 major) Technology of Functional Materials (2010) Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Economathematics (2009) Bachelor' degree (1 major) Economathematics (2008) Bachelor' degree (1 major) Mathematical Physics (2009) Bachelor' degree (1 major) Computational Mathematics (2009) Master's degree (1 major) Physics (2010) Master's degree (1 major) Technology of Functional Materials (2010) Master's degree (1 major) Technology of Functional Materials (2009)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 57 / 258

Master's degree (1 major) Functional Materials (2012)  
Bachelor's degree (1 major, 1 minor) Mathematics (Minor, 2008)  
First state examination for the teaching degree Gymnasium Mathematics (2009)

Module title		Abbreviation
Advanced Analysis		10-M-VAN-o82-mo1
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
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		
Lebesgue integral in several variables, including theorems on convergence and Fubini's theorem, $L^p$ -spaces and elementary Fourier theory in $L^2$ , Gauss's theorem.		
Intended learning outcomes		
The student is acquainted with advanced topics in analysis. Taking the example of the Lebesgue integral, he or she is able to understand the construction of a complex mathematical concept.		
Courses (type, number of weekly contact hours, language — if other than German)		
Ü + 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)		
written examination (approx. 90 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) Language of assessment: German, English if agreed upon with the examiner		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
§ 73 (1) 1. Mathematik Analysis		
Module appears in		
Bachelor' degree (1 major) Mathematics (2008) Bachelor' degree (1 major) Economathematics (2009) Bachelor' degree (1 major) Economathematics (2008) Bachelor' degree (1 major) Mathematical Physics (2009)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 59 / 258

Bachelor' degree (1 major) Computational Mathematics (2009)  
 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)  
 Bachelor's degree (1 major, 1 minor) Mathematics (Minor, 2008)  
 First state examination for the teaching degree Gymnasium Mathematics (2009)



Module title		Abbreviation
Electronics		11-A2-o81-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	undergraduate	--
<b>Contents</b>		
Principles of passive and active electronic components and their application in analogous and digital circuit technology.		
<b>Intended learning outcomes</b>		
The students have knowledge of the practical setup of electronic circuits from the field of analogous and digital circuit technology.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2009) Bachelor' degree (1 major) Physics (2008) Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2008) No final examination Special study offering (2010)		

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		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
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
Applied Semiconductor Physics		11-AHL-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
The lecture discusses the principles of Semiconductor Physics and provides an exemplary overview of the main components of electronics, optoelectronics and photonics.		
Intended learning outcomes		
The students know the characteristics of semiconductors, they have gained an overview of the electronic and phonon band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport as well as the Poisson, Boltzmann and continuity equation for the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the theories of planar technology and recent developments in this field, they have a basic understanding of component production. They understand the structure and way of functioning of the main components of electronics (diode, transistor, field-effect transistor, thyristor, diac, triac), of microwave applications (tunnel, Impatt, Baritt or Gunn diode) and of optoelectronics (photo diode, solar cell, light-emitting diode, semiconductor injection laser), they know the realisation possibilities of low-dimensional charge carrier systems on the basis of semiconductors and their technological relevance, they are familiar with current developments in the field of components.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		

<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Cosmology		11-AKM-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Expanding space-time, Friedmannian cosmology, basics of general relativity, the early universe, inflation, dark matter, primordial nucleosynthesis, cosmic microwave background, structure formation, supercluster, galaxies and galaxy clusters, intergalactic medium, cosmological parameters		
Intended learning outcomes		
The students have basic knowledge of cosmology. They know the theoretical methods of cosmology and are able to relate them to observations. They have gained insights into current research topics and are able to work on scientific questions.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		



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

--

**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
Practical Course Astrophysics		11-APP-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	(not) successfully completed	--
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		
Astrophysical experiments in the fields of detectors, telescopes, methodology, analysis and astronomic observations.		
Intended learning outcomes		
The students have mastered experimental methods of Astrophysics and are able to analyse and interpret the measuring data and present the results. They are familiar with the working methods of observational Astronomy and with basic techniques of detecting electromagnetic radiation. They are able to plan and evaluate observations and measurements and to present the results.		
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)		
a) Preparing, performing and evaluating the experiments will be considered successfully completed if a Testat (exam) is passed. Experiments that were not successfully completed can be repeated once. Or b) discussion to test the candidate's understanding of the physics-related contents and results of the experiment (approx. 20 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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 70 / 258

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (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) FOKUS Physics (2006)

Module title		Abbreviation
General Theory of Relativity		11-ART-112-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)
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		
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)		
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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 72 / 258

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 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) FOKUS Physics (2006)

Module title		Abbreviation
Reproducing Sensors in Infrared		11-ASI-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)
3	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		
Infrared cameras are important experimental and technical tools, e.g. for measuring temperatures. The spectral range of infrared ranges from the visible spectrum, where the Sun is dominating as the natural source of light, up to microwaves and radiowaves with artificial emitters. There is distinct and sometimes dominating emission from bodies with ambient temperature in the infrared spectrum. The lecture provides an introduction to the physical optics of this spectral range and discusses: Peculiarities of infrared cameras and thermal images, different types of sensors (bolometer, quantum well, superlattice) as well as the evaluation of such sensors on the basis of neurophysiological aspects.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of infrared spectral imaging. They know various technologies and detector structures as well as their application areas.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Master's with 1 major Physics (2010)		page 74 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
Bachelor' degree (1 major) Physics (2012)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Applied Superconduction		11-ASL-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Physical principles of superconductivity. Application in energy engineering. Instrumental developments. Methods of materials sciences for the calculation of temperature profiles in superconductors.		
Intended learning outcomes		
The students have a basic understanding of superconductivity as a macroscopic quantum phenomenon. They are able to evaluate the contributions of materials sciences to the development of superconductivity. They are able to discuss questions on superconductivity in a scientific manner and to critically question developments of energy technology. Furthermore, they can deal with practical mathematical questions.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: once a year, winter semester Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Physics (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 76 / 258



Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) Mathematics (2010)  
 Master's degree (1 major) Physics (2010)  
 Master's degree (1 major) Physics (2011)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
<b>Astronomical Methods</b>		11-ASM-131-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.
<b>Contents</b>		
Methods of observational astronomy across the electromagnetic spectrum. Extraction and reduction of observational data from radio, optical, X-ray and gamma-ray telescopes.		
<b>Intended learning outcomes</b>		
Overview of the methods used in observational astronomy in various parts of the electromagnetic spectrum (radio, optical, X-ray and gamma-ray energies). Knowledge of principles and applications of these methods and ability to conduct astronomical observations.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 78 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (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)

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"> <li>1. Overview</li> <li>2. Dynamics of charged particles in magnetic and electric fields</li> <li>3. Elements of space physics</li> <li>4. The sun and heliosphere</li> <li>5. Acceleration and transport of energetic particles in the heliosphere</li> <li>6. Instruments to measure energetic particles in extraterrestrial space</li> </ol>		
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		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Master's degree (1 major) Mathematics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>Master's degree (1 major) Computational Mathematics (2012)</p>

Module title		Abbreviation
Theoretical Astrophysics		11-AST-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	--
Contents		
Theoretical Astrophysics, models for the description of complex observation results, numeric simulations.		
Intended learning outcomes		
The students have basic knowledge of the methods of Theoretical Astrophysics. They are able to design complex observations and to test the models with the help of simulations.		
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)		
written examination (approx. 120 minutes)		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
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) 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) FOKUS Physics (2006)		

Module title		Abbreviation
Concepts of Theoretical Astroparticle physics		11-ATT-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)
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		
Concepts of Theoretical Astro-Particle Physics, e.g. Dark matter, cosmic radiation, neutrinos, baryogenesis, cosmic accelerators, dark energy, inflation.		
Intended learning outcomes		
The students have basic knowledge of the concepts of Theoretical Astroparticle Physics. They are able to describe phenomena of Astroparticle Physics on the basis of methods of Theoretical Physics and to find solution approaches for problems.		
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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 83 / 258

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) FOKUS Physics (2006)



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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 85 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

**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
Imaging Methods at the Synchrotron		11-BMS-121-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		
Overview of synchrotron radiation and its generation. - Principles of the interaction between radiation and matter. - Principles of X-ray optics, X-ray lens. - Synchrotron detector technique X-ray diffractometry (diffraction) of crystalline materials.		
Intended learning outcomes		
The students have advanced knowledge of synchrotron radiation and X-ray optics. They know the physical principles of imaging techniques at the synchrotron and their application for crystalline materials and other materials. They understand the principles of image generation and are able to explain different techniques and interpret simple images.		
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 (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 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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 87 / 258

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 (2010)

Module title		Abbreviation
Imaging Methods at the Synchrotron		11-BMS-131-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 semesters.
Contents		
Overview of synchrotron radiation and its generation. - Principles of the interaction between radiation and matter. - Principles of X-ray optics, X-ray lens. - Synchrotron detector technique X-ray diffractometry (diffraction) of crystalline materials.		
Intended learning outcomes		
The students have advanced knowledge of synchrotron radiation and X-ray optics. They know the physical principles of imaging techniques at the synchrotron and their application for crystalline materials and other materials. They understand the principles of image generation and are able to explain different techniques and interpret simple images.		
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) 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 89 / 258

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 (2010)

Module title		Abbreviation
<b>Biophysical Measurement Technology in Medical Science</b>		11-BMT-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
The lecture covers the physical principles of imaging techniques and their application in Biomedicine. The main topics are conventional X-ray technique, computer tomography, imaging techniques of nuclear medicine, ultrasound and MR-tomography. The lecture additionally addresses systems theory of imaging systems and digital image processing.		
Intended learning outcomes		
The students know the physical principles of imaging techniques and their application in Biomedicine. They understand the principles of image generation and are able to explain different techniques and interpret simple images.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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) Functional Materials (2012)



Module title		Abbreviation
Image and Signal Processing in Physics		11-BSV-122-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		
Periodic and aperiodic signals; principles of discreet and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parsival theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.		
Intended learning outcomes		
The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.		
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 (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 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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 93 / 258

**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) 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 (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Image and Signal Processing in Physics		11-BSV-131-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 semesters.
Contents		
Periodic and aperiodic signals; principles of discrete and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parseval theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.		
Intended learning outcomes		
The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.		
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) 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 95 / 258

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) 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 (2010)

Module title		Abbreviation
Computational Materials Science		11-CMS-122-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		
Density functional theory (DFT)/local-density approximation (exercise with "Wien2k"; band structure programme, Green's functions, quantum dots, Anderson impurity model (exercise, implementation of the exact diagonalisation/Lanczos), introduction to continuous-time quantum Monte Carlo (exercise), crystal field symmetry, Coulomb interaction, dynamic mean field theory (DMFT exercise). Lecture + 4-5 exercises in the CIP pool. The exercises implement the basic ideas of different algorithms, either based on template programmes or on completely self-written programmes. Electronic submission of all exercises and approx. 20 minutes presentation about one of the 4-5 topics of the lecture/exercise (freely chosen by the student) with a little more elaboration on the topic than in the exercise.		
Intended learning outcomes		
Theoretical treatment of the above topics complemented by hands-on tutorials to be held in the CIP-Pool. Familiarity with DFT software packages such as VASP or Wien2k and construction of maximally localized Wannier functions by projecting DFT results onto atomic orbitals using wannier90. Focus on applications to topological materials. Knowledge how to obtain many-body solutions of the AIM and explore some of its limiting cases such as the Kondo regime. Ability to use impurity solvers based on exact diagonalization or continuous-time quantum Monte Carlo for the solution of the DMFT self-consistency equations.		
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 (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 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 or English		
Allocation of places		
--		
Additional information		
--		
Master's with 1 major Physics (2010)		page 97 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
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 (2010)

Module title		Abbreviation
Computational Materials Science		11-CMS-131-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 semesters.
Contents		
Density functional theory (DFT)/local-density approximation (exercise with "Wien2k"; band structure programme, Green's functions, quantum dots, Anderson impurity model (exercise, implementation of the exact diagonalisation/Lanczos), introduction to continuous-time quantum Monte Carlo (exercise), crystal field symmetry, Coulomb interaction, dynamic mean field theory (DMFT exercise). Lecture + 4-5 exercises in the CIP pool. The exercises implement the basic ideas of different algorithms, either based on template programmes or on completely self-written programmes. Electronic submission of all exercises and approx. 20 minutes presentation about one of the 4-5 topics of the lecture/exercise (freely chosen by the student) with a little more elaboration on the topic than in the exercise.		
Intended learning outcomes		
The students have advanced knowledge of mathematical methods of material sciences. They are able to develop algorithms for the application of these methods and to implement them into programmes.		
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) 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

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 (2010)



Module title		Abbreviation
Critical Phenomena		11-CRP-131-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		
In Statistical Physics, critical phenomena refer to the universal behaviour in the proximity of continuous phase transitions. The theory, which can be explained through critical phenomena, is called renormalisation group and plays an important role in many areas of Physics. The lecture serves as an introduction to critical phenomena and to renormalisation group theory and discusses selected applications. Basic phenomenology: Universality, scaling relationships, critical exponents. Mean field theory. Renormalisation group theory. Duality and high-/low-temperature development. Finite size scaling theory. Exact solutions.		
Intended learning outcomes		
The students know the principles of the theory of critical phenomena and are able to apply the calculation methods to simple problems.		
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 project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks), 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

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)

Module title		Abbreviation
<b>Density Functional Theory and the Physics of Oxide Heterostructure</b>		11-DFT-142-m01
Module coordinator		Module offered by
chairperson of examination committee		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	--
<b>Contents</b>		
The students are familiar with the physical values of oxide heterostructures and with the principles and methods of density functional theory. They are able to model problems of Theoretical Physics with the help of important programmes such as Wien2k or VASP. They can make simple calculations with the help of density functional theory.		
<b>Intended learning outcomes</b>		
The students are familiar with the physical values of oxide heterostructures and with the principles and methods of density functional theory. They are able to model problems of Theoretical Physics with the help of important programmes such as Wien2k or VASP. They can make simple calculations with the help of density functional theory.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + D (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 (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: approx. 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 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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 (2010) Master's degree (1 major) FOKUS Physics (2011)		

Module title		Abbreviation
Particle Radiation Detectors		11-DTS-111-mo1
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.
<b>Contents</b>		
Principles of interaction between particles and matter. Particle detectors for space and time measurement, determination of momentum, energy and particle identification. Conception of particle detectors in examples.		
<b>Intended learning outcomes</b>		
The students know the physical principles and the basic structure of particle detectors. They know the functions and applications of different types of detectors, they can explain the measurement of physical values and have basic knowledge of the conception of detector systems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 104 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (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) FOKUS Physics (2006)

Module title		Abbreviation
Principles of Image Processing		11-EBV-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)
3	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		
Introduction to image processing. Pictures as two-dimensional signals; digitalisation. Two-dimensional Fourier transform. Histogram equalisation (e.g. image brightening) and pixel connectivity (e.g. noise reduction). Automatic image recognition: Segmentation, classification. Technological image generation. Applications (e.g. motion tracking). Three-dimensional images.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of image processing. They know the principles and theory of signal processing for images and have corresponding knowledge of image generation. They are able to independently work with literature, they understand the characteristics of image processing with commercial software and are able to process images for the analysis of experiments with imaging measuring methods.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
Bachelor' degree (1 major) Physics (2012)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Electron Electron Interaction		11-EEW-102-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)
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		
1. Introduction, systems, Landau theory 2. Interacting electron gas. 3. One-dimensional electron gas (without interaction). 4. Introduction to boson phase fields and interactions. 5. Calculation of correlation functions. 6. Method of functional integrals. 7. Renormalisation groups. 8. Consideration of spin. 9. One-dimensional lattice models. 10. Impurities in Luttinger liquids		
Intended learning outcomes		
The students know the principles of the theoretical description of electron-electron interactions in one dimension.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		



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

--

**Module appears in**

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 (2010)  
Master's degree (1 major) FOKUS Physics (2011)  
Master's degree (1 major) FOKUS Physics (2006)

Module title		Abbreviation
Principles of Energy Technologies		11-ENT-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Physical principles of energy conservation and energy conversion, energy transport and energy storage as well as renewable resources of energy. We also discuss aspects of optimising materials (e.g. nanostructured insulating materials, selective layers, highly activated carbons). The course is especially suitable for teaching degree students. Energy conservation via thermal insulation. Thermodynamic energy efficiency. Fossil fired energy converters. Nuclear power plants. Hydroelectricity. Wind turbines. Photovoltaics. Solar thermal: Heat. Solar thermal: Electricity. Biomass. Geothermal energy. Energy storage. Energy transport		
Intended learning outcomes		
The students know the principles of different methods of energy technology, especially energy conversion, transport and storage. They understand the structures of corresponding installations and are able to compare them.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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) Functional Materials (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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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
Introduction to Elementary Particle Theory		11-ETT-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)
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.
<b>Contents</b>		
Symmetries in Particle Physics. Quark model of hadrons. Feynman rules. Simple processes in quantum electrodynamics and in the standard model. Parton model and deep inelastic lepton-nucleon scattering.		
<b>Intended learning outcomes</b>		
The students have in-depth knowledge of Theoretical Elementary Particle Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 114 / 258

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) FOKUS Physics (2006)

Module title		Abbreviation
Current Topics in Experimental Physics		11-EXE5-111-m01
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
<b>Contents</b>		
Current topics of Experimental Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
<b>Intended learning outcomes</b>		
The students have advanced competencies corresponding to the requirements of a module of Experimental Physics of the Master's programme. They have knowledge of a current subdiscipline of Experimental Physics and understand the measuring and/or evaluation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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) FOKUS Physics (2006)		



Module title		Abbreviation
Current Topics in Experimental Physics		11-EXE6-111-mo1
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Current topics of Experimental Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental Physics of the Master's programme. They have knowledge of a current subdiscipline of Experimental Physics and understand the measuring and/or evaluation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Current Topics in Experimental Physics		11-EXE7-111-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
7	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval by examination committee required.
Contents		
Current topics of Experimental Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental Physics of the Master's programme. They have knowledge of a current subdiscipline of Experimental Physics and understand the measuring and/or evaluation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		

Module title		Abbreviation
Current Topics in Experimental Physics		11-EXE8-111-mo1
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Current topics of Experimental Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental Physics of the Master's programme. They have knowledge of a current subdiscipline of Experimental Physics and understand the measuring and/or evaluation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		

Module title		Abbreviation
Non-Physical Minor Subject		11-EXNP6-112-m01
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Non-physical minor. Accredited academic achievements, e.g. in case of change of university or study abroad		
Intended learning outcomes		
The students have advanced competencies on the Master's level which correspond to the requirements of a module in the field of a non-physical minor (mathematics, chemistry, informatics...).		
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) Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011)		

Module title		Abbreviation
Current Topics in Theoretical Physics		11-EXT5-111-m01
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Current topics of Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Theoretical Physics of the Master's programme. They have advanced specialist knowledge of a subdiscipline of Theoretical Physics and have mastered the required methods. They are able to apply the acquired methods to current problems of Theoretical Physics.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		

Module title		Abbreviation
Current Topics in Theoretical Physics		11-EXT6-111-m01
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Current topics of Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Theoretical Physics of the Master's programme. They have advanced specialist knowledge of a subdiscipline of Theoretical Physics and have mastered the required methods. They are able to apply the acquired methods to current problems of Theoretical Physics.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Current Topics in Theoretical Physics		11-EXT7-111-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
7	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval by examination committee required.
Contents		
Current topics of Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Theoretical Physics of the Master's programme. They have advanced specialist knowledge of a subdiscipline of Theoretical Physics and have mastered the required methods. They are able to apply the acquired methods to current problems of Theoretical Physics.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		



Module title		Abbreviation
Current Topics in Theoretical Physics		11-EXT8-111-m01
Module coordinator		Module offered by
chairperson of examination committee		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	Approval by examination committee required.
Contents		
Current topics of Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Theoretical Physics of the Master's programme. They have advanced specialist knowledge of a subdiscipline of Theoretical Physics and have mastered the required methods. They are able to apply the acquired methods to current problems of Theoretical Physics.		
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, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified) 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)		
Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		



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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 125 / 258

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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 127 / 258

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
<b>Solid State Spectroscopy 2</b>		11-FKS2-132-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	--
Contents		
Modern scattering methods; neutron scattering as a method to investigate the atomic and magnetic structure and excitations such as phonons and magnetic waves; resonant elastic X-ray scattering and absorption; investigation of magnetic, orbital and charge order; X-ray and neutron reflectometry; investigation of the structural, magnetic and electronic properties of thin films and superlattices; resonant inelastic X-ray scattering; investigation of excitations in solids and thin films; STEM ("scanning transmission electron microscopy"); further topics upon agreement.		
Intended learning outcomes		
The students know different modern scattering methods such as neutron scattering, resonant elastic X-ray scattering, modern scattering theory, X-ray and neutron reflectometry and resonant inelastic X-ray scattering. They are familiar with the theoretical principles and applications of these methods.		
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) 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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 (2010) Master's degree (1 major) FOKUS Physics (2011)		

Module title		Abbreviation
Transport Phenomena in Solids		11-FKT-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
<b>Contents</b>		
Transport phenomena in solids.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge in the field of transport phenomena in solids.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 130 / 258

Master's degree (1 major) Mathematics (2010)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Visiting Research Project		11-FPA-112-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)
10	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval by examination committee required.
Contents		
Independent work on a current research topic of Experimental and Theoretical Physics. Implementation of scientific experiments including analysis and documentation of the results, especially in the context of research visits to other universities or research institutes.		
Intended learning outcomes		
The students are able to independently work on a current research area of Experimental or Theoretical Physics, to conduct and analyse scientific experiments and to document the results.		
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)		
project report (approx. 10 to 20 pages) Language of assessment: German, English		
Allocation of places		
--		
Additional information		
Additional information on module duration: 1 to 2 semesters.		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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)		



<b>Module title</b>		<b>Abbreviation</b>
Professional Specialization Physics		11-FS-P-072-m01
<b>Module coordinator</b>		<b>Module offered by</b>
chairperson of examination committee		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
15	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Introduction to current experimental or theoretical questions of a subdiscipline of Physics with special relevance to the planned topic of the Master's thesis. Summary of the required fundamental topics in a seminar presentation.		
<b>Intended learning outcomes</b>		
The students have advanced knowledge of a current experimental or theoretical subdiscipline of Physics with a special relevance to the intended topic of the Master's thesis. They know the current state of research in this area and are able to summarise their knowledge in an oral presentation.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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. 30 to 45 minutes) with discussion		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010)		
Master's degree (1 major) Physics (2011)		

Module title		Abbreviation
Field Theory in Solid State Physics		11-FTFK-112-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		
<p>This will usually be a course on quantum many particle physics using the method of functional integration. An outline could be:</p> <ol style="list-style-type: none"> <li>1 Coherent states and review of second quantization</li> <li>2 The functional integral formalism at finite temperatures <math>T</math></li> <li>3 Perturbation theory at <math>T=0</math></li> <li>4 Order parameters and broken symmetry</li> <li>5 Green's functions</li> <li>6 The Landau theory of Fermi liquids</li> <li>7 Further developments</li> </ol>		
Intended learning outcomes		
The students have mastered the principles of quantum field theory in many-particle systems. They are able to apply the acquired methods to current problems of Theoretical Solid-State Physics.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
<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>		
Allocation of places		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
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 (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) FOKUS Physics (2006)

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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 136 / 258

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
<b>Semiconductor Lasers - Principles and Current Research</b>		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		
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.		
Intended learning outcomes		
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.		
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		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2010)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2012)</p> <p>Master's degree (1 major) Mathematics (2012)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>Master's degree (1 major) Computational Mathematics (2012)</p> <p>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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 140 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		



**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
<b>Semiconductor Nanostructures</b>		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		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2010)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2012)</p> <p>Master's degree (1 major) Mathematics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Technology of Functional Materials (2010)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>Master's degree (1 major) Computational Mathematics (2012)</p> <p>Master's degree (1 major) Functional Materials (2012)</p>

Module title		Abbreviation
Introduction to Electron Microscopy		11-IEM-111-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		
1. Microscopy with light and electrons. 2. Electrons and their interaction with a specimen. 3. Electron diffraction (selected-area ED, convergent beam ED, basics of electron crystallography, comparison with the X-ray diffraction technique). 4. Transmission electron microscopy (the instrument, contrast mechanisms, principles of image formation, imaging of microstructure). 5. Can we see atoms? High-resolution electron microscopy (principle of image formation, image simulation). 6. Scanning electron microscopy (the instrument, contrast mechanisms). 7. Chemical analysis with the electron microscope (energy-dispersive X-ray microanalysis, electron energy loss spectroscopy). 8. Sample preparation. Electron microscopy and complementary techniques.		
Intended learning outcomes		
The students have basic knowledge of modern research methods of electron microscopy up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as electron-microscopic methods for chemical analysis. They are able to evaluate the efficiency of different research methods.		
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		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<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) 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 (2010)          Master's degree (1 major) FOKUS Physics (2011)          Master's degree (1 major) Functional Materials (2012)          Master's degree (1 major) FOKUS Physics (2006)</p>

Module title		Abbreviation
Principles of Classification of Patterns		11-KVM-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)
3	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		
Signals such as images, but also acoustic records, spectra, electrical measurements often contain recurring patterns. These patterns are often classified and analysed by observers, e.g. by a doctor when analysing an ECG. More and more automatic procedures are adopted to take on these tasks and classify patterns. The lecture will discuss principles of different classifiers such as "minimum distance" and "maximum likelihood".		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of pattern recognition. They know methods of classifying patterns in measuring data as well as ways to automatise these processes. They are able to apply these methods to practical problems.		
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 (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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
Bachelor' degree (1 major) Physics (2012)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
<b>Lithography in Semiconductor Technology and Theory of Quantum Transport</b>		11-LHQ-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		
Introduction to the lithographic techniques of semiconductor technology and discussion of the required theory on quantum transport.		
Intended learning outcomes		
The students have specific and advanced knowledge of semiconductor lithography and of the theory of quantum transport.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Physics (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 148 / 258



Bachelor' degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Laboratory and Measurement Technology in Biophysics		11-LMB-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
The lecture covers relevant principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. The main topics are optical measuring techniques and sensors, methods of single-particle detection, special microscopy techniques and methods of structure elucidation of biomolecules.		
Intended learning outcomes		
The students know the principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. They have knowledge of optical measuring techniques and their applications and are able to apply techniques of structure elucidation to simple biomolecules.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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) Functional Materials (2012)

Module title		Abbreviation
Introduction to LabVIEW		11-LVW-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>The module comprises basic and advanced courses. The basic course "NI LabVIEW Basic 1" is the first level of each LabVIEW learning phase. LabVIEW Basic provides a systematic introduction to the functions and application fields of the development environment of LabVIEW. The students become acquainted with dataflow programming and with common LabVIEW architectures. They learn to develop LabVIEW applications for various application fields, from assessment and measurement applications up to data collection, device control, data recording and measurement analysis. In the advanced course "NI LabVIEW Core 2", the students learn to develop comprehensive standalone applications, including the graphical development environment LabVIEW. The course builds upon LabVIEW Basic 1 and provides an introduction to the most common development technologies, in order to enable the students to successfully implement and distribute LabVIEW applications for different application fields. Course topics include techniques and procedures for the optimisation of application performance, e.g. through an optimised reuse of existing codes, usage of file I/O functions, principles of data management, event computing and methods of error handling. After finishing the course, the students have the ability to apply LabVIEW functions according to individual requirements, which enables a fast and productive application development.</p>		
Intended learning outcomes		
The students have specific and advanced knowledge in the application field of LabVIEW. They know the principles of working with LabVIEW and are able to develop applications, e.g. for recording and analysing measuring data.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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) or e) project (approx. 60 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		
--		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 152 / 258

<b>Additional information</b>
--
<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
<b>Magnetism</b>		11-MAG-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain structure, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo effect.		
Intended learning outcomes		
The students know basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas; they have competencies in independently working on problems of these areas; they are able to evaluate the accuracy of observations and analyses.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) Mathematics (2010)  
 Master's degree (1 major) Physics (2010)  
 Master's degree (1 major) Physics (2011)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Master Thesis Physics		11-MA-P-072-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
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 to be carried out electronically. Deadlines will be announced separately. Please consult with your supervisor.
<b>Contents</b>		
Mostly independent processing of an experimental or theoretical task in the field of Physics, especially according to known procedures and scientific aspects; writing of the thesis.		
<b>Intended learning outcomes</b>		
The students are able to independently work on an experimental or theoretical task from Physics, especially according to known methods and scientific aspects and to summarise their results in a final paper.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
no courses assigned		
<b>Method of assessment</b> (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 (approx. 75 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010)		



Module title		Abbreviation
Modern Astrophysics		11-MAS-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)
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		
Introduction to a field of modern Astrophysics, e.g. extra-galactic jets.		
Intended learning outcomes		
The students know the current state of research on the modern topic of Astrophysics. They know the physical values and are to plan and conduct observations in this area. This includes the ability to conceptualise a specific observational project and e.g. to apply for observation time at large telescopes.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 157 / 258

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) FOKUS Physics (2006)

Module title		Abbreviation
<b>Opto-electronic Material Properties</b>		11-MOE-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	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.
<b>Contents</b>		
Physical principles of optoelectronic material properties and applications.		
<b>Intended learning outcomes</b>		
The students know the principles of optoelectronic material characteristics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2010) Master's degree (1 major) Physics (2010) 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) Nanostructure Technology (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 159 / 258

Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)  
Master's degree (1 major) Functional Materials (2012)

Module title		Abbreviation
<b>Scientific Methods and Project Management Physics</b>		11-MP-P-072-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
15	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Introduction to the methods of scientific work, taking into account methods of project planning. Application to theoretical and experimental questions of Physics, writing of a scientific project plan for the planned Master's thesis.		
Intended learning outcomes		
The students have knowledge of scientific methods and methodological work, including project planning methods of a current experimental and theoretical subdiscipline of Physics with special relevance to the intended topic of the Master's thesis. They are able to draft a project plan for the Master's thesis and to plan the required experimental or theoretical work. They are able to describe their projects in oral presentations.		
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. 30 to 45 minutes) with discussion		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2010)		
Master's degree (1 major) Physics (2011)		

Module title		Abbreviation
Methods in Surface Spectroscopy		11-MSS-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)
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		
Boundary conditions of experiments: Ultra-high vacuum, surface sensibility, light-matter-interaction, principles of photoelectron spectroscopy (PES), one-particle image of PES, three step model, many-particle effects, line shape, satellites, Fermi liquid, quasiparticles, exemplary systems and spectra, measurements with synchrotron radiation, related experimental methods.		
Intended learning outcomes		
The students know the physical principles and experimental methods of surface spectroscopy. They are able to conduct, evaluate and interpret simple measurements.		
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)		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 162 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

**Module appears in**

Bachelor' degree (1 major) Nanostructure Technology (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 (2010)  
Master's degree (1 major) FOKUS Physics (2011)  
Master's degree (1 major) FOKUS Physics (2006)

Module title		Abbreviation
<b>Magnetism and Spin Transport</b>		11-MST-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
2 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
The module spans two semesters. During the winter semester, the students become acquainted with the principles of magnetism (ranging from atoms to solids), properties of magnetic material (individual usage) and methods to characterise magnetic properties. During the summer semester, the students learn about spin transport in metallic systems in due consideration of giant magnetoresistance and tunnel magnetoresistance and its application in magnetic memory. As a last point, we discuss new phenomena from the field of spin dynamics and current-induced spin phenomena.		
Intended learning outcomes		
The students know the basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are familiar with spin transport applications of information technologies and have gained an overview of modern findings in this area (GMR, TMR). They are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + 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		
--		
Additional information		
--		
Workload		
--		



<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p>

Module title		Abbreviation
Nanoanalytics		11-NAN-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		
Principles of analytic procedures in the field of nanostructure physics, imaging techniques from a microscopic level up to an atomic level, examination of chemical composition, spectroscopy of electronic properties, usage of X-ray methods. - Physics and material systems on the nanoscale. - Scanning probes: Atomic force microscopy. Scanning tunneling microscopy. - Electron probes: Scanning electron microscope. Transmission electron microscope. - Secondary ions - mass spectrometry - X-ray methods: Synchrotron spectroscopy. Photoemission. X-ray absorption		
Intended learning outcomes		
The students have basic knowledge of modern research methods for different nanostructures up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as spectroscopic methods for the determination of electronic properties. They are able to evaluate the efficiency of different research methods.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2010)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2012)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>Master's degree (1 major) Functional Materials (2012)</p>

Module title		Abbreviation
Low-Dimensional Structures		11-NDS-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Low-dimensional structures: Crystal lattice symmetry. Lattice dynamics and growth techniques of low-dimensional structures. Comparison between these structures and volume solids. X-ray diffractometry. Molecular beam epitaxy.		
Intended learning outcomes		
The students have knowledge of the theoretical principles of the growth of low dimensional structures. They know methods of producing and analysing such structures. They know the bandstructures of the most important semiconductors as well as the fabrication and characteristics of semiconductor heterostructures and MOS-diodes. They are familiar with the subband structure of semiconductor heterostructures and MOS-diodes and can evaluate the importance of many-particle effects. They are able to solve problems related to potentials in one dimension by applying Poisson's equation. They know the $k \cdot p$ perturbation theory and can deduce the 2D subband structure from the bulk band structure. They have knowledge of the meaning of modulation doping and are familiar with the 2D hydrogen atom. They understand how an external magnetic field acts on the properties of a free electron gas in 2D. They have basic knowledge of the meaning of gauging, Landau-quantisation, filling factor and Landau degeneracy. They understand the dependence of various physical properties on the filling factor, and are able to solve implicit problems via numerical methods. They are familiar with elementary excitations in two-dimensional systems.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		

Additional information
--
Workload
--
Teaching cycle
--
Referred to in LPO I (examination regulations for teaching-degree programmes)
--
Module appears in
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011) Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Nanoelectronics		11-NEL-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
The lecture and the corresponding exercises convey basic concepts of electronics of nanostructures. First, we discuss terms such as Fermi distribution, density of states and carrier concentration in view of small structures. Afterwards, we talk about application potentials of nanostructures in electronics. We examine the limits of the function of common switches and storages through miniaturisation and compare them to electronic properties of nanostructures. We gain an overview of nanoelectric amplifiers, rectifier, logic lattices and circuits and discuss the operating principle of quantum computers.		
Intended learning outcomes		
The students have mastered the basics of electronics of nanostructures in theory and practice. They know functions and applications of respective components.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
Bachelor' degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Numerical Methods in Astrophysics		11-NMA-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Various methods used in astrophysical simulations with special emphasis on their applications. N-body algorithms (tree- and polynomial codes). Particle-mesh methods (particle-in-cell methods). Vlasow methods (e.g., Lattice-Boltzmann). Hyperbolic conservation laws (fluid dynamics, finite difference method, Riemann solver, ENO). Methods of high-performance computing. Message-passing interface (MPI). GPGPU programming (OpenCL).		
Intended learning outcomes		
The students are able to solve typical problems and equations of Astrophysics and other subdisciplines of Physics with the help of numerical simulations. They are especially capable of choosing adequate strategies to approach such problems and of validating the results.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Master's with 1 major Physics (2010)		page 172 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		



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

--

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
Bachelor' degree (1 major) Mathematical Physics (2009)  
Master's degree (1 major) Mathematics (2010)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) FOKUS Physics (2010)

Module title		Abbreviation
Nano-Optics		11-NOP-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Theoretical principles. Focussing of light. Microscopy. Optical nearfield probes. Nearfield microscopy. Single quantum emitters. Light emission in nano-tailored environments. Plasmons. Optical antennas.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of nano-optics. They are familiar with the theoretical principles and application areas of nano-optics and with current developments in this field.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Physics (2010)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 174 / 258

Bachelor' degree (1 major) Physics (2012)  
Master's degree (1 major) Mathematics (2010)  
Master's degree (1 major) Physics (2010)  
Master's degree (1 major) Physics (2011)  
Master's degree (1 major) Nanostructure Technology (2011)  
Master's degree (1 major) Nanostructure Technology (2010)  
Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
Master's degree (1 major) FOKUS Physics (2010)  
Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Organic Semiconductor		11-OHL-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	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		
Physical principles of organic semiconductors, molecular and polymer electronics and sensor technology, applications.		
Intended learning outcomes		
The students have advanced knowledge of organic semiconductors.		
Courses (type, number of weekly contact hours, language — if other than German)		
V + Ü (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012) Master's degree (1 major) Physics (2010) Master's degree (1 major) Physics (2011)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 176 / 258

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) 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) Functional Materials (2012)

Module title		Abbreviation
Advanced Seminar Experimental/Theoretical Physics		11-OSP-072-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)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Seminar on current issues of Theoretical or Experimental Physics.		
Intended learning outcomes		
The students have advanced knowledge of a current specialist field of Experimental or Theoretical Physics. They are able to extract knowledge from professional publications and to summarise this knowledge and present it to a professional audience.		
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)		
talk with discussion (approx. 30 to 45 minutes)		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
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) FOKUS Physics (2006)		

Module title		Abbreviation
Advanced Practical Course Master		11-PFM-072-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	(not) successfully completed	11-E1, 11-E2
Duration	Module level	Other prerequisites
1 semester	graduate	11-A3
Contents		
Principles of Nuclear, Atomic and Molecular Physics, experiments on cryogenic temperatures and correlated systems, properties of solids, surfaces and interfaces. Experiments on the following topics: X-rays - nuclear magnetic resonance (NMR) - quantum Hall effect - optical pumping and spectroscopy in the field of optics - Hall effect - superconductivity - laser - solid-state optics		
Intended learning outcomes		
Knowledge of conducting experiments, analysing and documenting experimental results, basic knowledge of issuing scientific publications, application of modern evaluation systems, working on a task based on publications and acquiring practical experimental methods.		
Courses (type, number of weekly contact hours, language — if other than German)		
Fortgeschrittenen-Praktikum Master (Advanced Practical Course Master) Part 1: P (3 weekly contact hours), German or English Fortgeschrittenen-Praktikum Master (Advanced Practical Course Master) Part 2: P (3 weekly contact hours), German or English		
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>This module has the following assessment components</p> <ol style="list-style-type: none"> <li>1. Lab course in part 1 (Fortgeschrittenen-Praktikum Master/Advanced Practical Course Master Part 1): a) Preparing the experiment will be considered successfully completed if an oral test (approx. 30 minutes) is passed prior to the experiment. b) Performing and evaluating the experiment will be considered successfully completed if a test is passed. Students must prepare an experiment log (approx. 8 pages).</li> <li>2. Lab course in part 2 (Fortgeschrittenen-Praktikum Master/Advanced Practical Course Master Part 2): a) Preparing the experiment will be considered successfully completed if an oral test (approx. 30 minutes) is passed prior to the experiment. b) Performing and evaluating the experiment will be considered successfully completed if a test is passed. Students must prepare an experiment log (approx. 8 pages).</li> </ol> <p>Language of assessment: German or English Students must register for assessment components 1 and 2 online (details to be announced). Students will be offered one opportunity to retake element a) and/or element b) in the respective semester. To pass an assessment component, they must pass both elements (a and b) in the same semester. To pass this module, students must pass both assessment component 1 and assessment component 2.</p>		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 179 / 258

**Module appears in**

Master's degree (1 major) Physics (2010)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006)  
 Master's degree (1 major) FOKUS Physics (2006)



Module title		Abbreviation
Physics of Complex Systems		11-PKS-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
1. Theory of critical phenomena in thermal equilibrium 2. Introduction into the physics out of equilibrium 3. Entropy production and fluctuations 4. Phase transitions away from equilibrium 5. Universality 6. Spin glasses 7. Theory of neural networks		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of physics of complex systems. They know the methods of Statistical Physics, Computational Physics and non-linear dynamics, which are used to describe such systems. They are able to work on current research problems in this area.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2012)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2009)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p>

Module title		Abbreviation
Physics of Advanced Materials		11-PMM-132-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	--
<b>Contents</b>		
General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.		
<b>Intended learning outcomes</b>		
The students know the properties and characterising methods of some modern materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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) 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 (2010) Master's degree (1 major) FOKUS Physics (2011)		

Module title		Abbreviation
Quantum Field Theory II		11-QFT2-092-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		
Quantum field theory II. Generating functionals. Path integral. Renormalisation. Renormalisation group. Gauge theories. Spontaneous symmetry breaking. Effective field theory (optional).		
Intended learning outcomes		
The students have advanced knowledge of the methods and concepts of quantum field theory. They have mastered the principles, especially of renormalisation and gauge theories. They are able to formulate and solve simple problems of quantum field theory by using the acquired calculation methods.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 184 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

### Module appears in

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Mathematical Physics (2009)  
 Bachelor' degree (1 major) Mathematical Physics (2012)  
 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)

Module title		Abbreviation
Quantum Information and Quantum Computing		11-QIC-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		
The first part introduces the theoretical concepts of quantum information and quantum computers. It discusses the main quantum algorithms. The second part discusses experimental possibilities for the realisation of entangled states. One of the main topics is the production, controlling and manipulation of coherent two-electron spin states. The third part covers the description and explanation of decoherence of quantum mechanical states.		
Intended learning outcomes		
The students have an advanced understanding of quantum theory and basic knowledge of quantum calculation. They are able to solve simple problems of quantum information theory.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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) Physics (2010)  
 Master's degree (1 major) Physics (2011)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) Mathematical Physics (2012)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Quantum Mechanics II		11-QM2-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
<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"> <li>1. Second quantisation: Fermions and bosons</li> <li>2. Band structures of particles in a crystal</li> <li>3. Angular momentum, symmetry operators, Lie Algebras</li> <li>4. Scattering theory: Potential scattering, partial wave expansion</li> <li>5. Relativistic quantum mechanics: Klein-Gordon equation, Dirac equation, Lorentz group, fine structure splitting of atomic spectra</li> <li>6. Quantum entanglement</li> <li>7. Canonical formalism</li> </ol>		
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 Physics (2010)		page 188 / 258



<b>Allocation of places</b>
--
<b>Additional information</b>
--
<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Nanostructure Technology (2012)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2009)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) Mathematics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>Master's degree (1 major) Computational Mathematics (2012)</p>

Module title		Abbreviation
Quantum Phenomena in electronic correlated Materials		11-QPM-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Quantum effects and phenomena in current solid-state research. Correlations. Free electron gas and Fermi liquid. Strongly correlated systems		
Intended learning outcomes		
The students have specific, advanced knowledge of the current research on Solid-State Physics, especially on quantum effects in strongly correlated systems. They are able to understand the connections between the theoretical description of such systems and the current experimental results.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 190 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Master's degree (1 major) Mathematics (2010)  
 Master's degree (1 major) Physics (2010)  
 Master's degree (1 major) Physics (2011)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Quantum Loop Gravity		11-QSG-102-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)
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		
Aside from string theory, quantum loop gravity (QLG) is one of the most important approaches to a quantum mechanical description of gravity. General relativity is formulated in Hamiltonian formalism and the elemental variables are identified with the corresponding Poisson brackets. These variables are quantised in the typical manner on discretised graphs, so-called spin networks. In doing so, e.g. a quantisation of elemental volumes appears. Therefore, QLG belongs to the speculative theories which paint a picture of the constitution of space and time.		
Intended learning outcomes		
The students know the principles of quantum loop gravity. They have acquired advanced knowledge of a selected topic and have proved their knowledge in a seminar presentation.		
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)		
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) Language of assessment: German, English 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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010

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

--

**Module appears in**

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) FOKUS Physics (2006)

Module title		Abbreviation
Quantum Information Technology		11-QUI-132-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	--
<b>Contents</b>		
Basic concepts of quantum mechanics, quantum bits and algorithms, quantal measurements, experimental approaches towards quantum computing (on the basis of photons, ions and nuclear spins), quantum operations and quantum noise, quantum information and communication.		
<b>Intended learning outcomes</b>		
The students are familiar with the basic quantum mechanical terms of quantum information technology. They know experimental approaches for the realisation of quantum computers and for the transfer of quantum information.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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 (2010) Master's degree (1 major) FOKUS Physics (2011)		

Module title		Abbreviation
Many Body Quantum Theory		11-QVTP-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
<p>This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions.</p> <p>An outline could be:</p> <ol style="list-style-type: none"> <li>1 Single-particle Green's function</li> <li>2 Review of second quantization</li> <li>3 Diagrammatic method using many particle Green's functions at temperature <math>T=0</math></li> <li>4 Diagrammatic method for finite <math>T</math></li> <li>5 Landau theory of Fermi liquids</li> <li>6 Superconductivity</li> <li>7 One-dimensional systems and bosonization</li> </ol>		
Intended learning outcomes		
The students have mastered the principles of quantum field theory in many-particle systems. They are able to apply the acquired methods to current problems of Theoretical Solid-State Physics.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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		
--		
Additional information		
--		
Master's with 1 major Physics (2010)		page 195 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2009)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2011)</p> <p>Master's degree (1 major) Nanostructure Technology (2010)</p> <p>Master's degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p>



Module title		Abbreviation
Renormalization Group Methods in Field Theory		11-RMFT-102-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 non-linear partial differential equations, field theoretical contexts and non-analysed behaviour of cryogenic temperatures.		
Intended learning outcomes		
The students gain an overview of non-linearities in partial differential equations and their solution on the basis of the renormalisation group method.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 197 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Mathematical Physics (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) Mathematical Physics (2012)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics (2011)  
 Master's degree (1 major) FOKUS Physics (2006)

Module title		Abbreviation
Relativistic Effects in Mesoscopic Systems		11-RMS-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Relativistic effects in mesoscopic systems. - Spin-orbit coupling. - Dirac equation. - Quantum Hall effect. - Topological insulators. - Majorana fermions		
Intended learning outcomes		
The students have mastered the mathematical methods for the description of relativistic quantum systems, especially in the field of mesoscopic physics. They are able to apply their knowledge to simple systems.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 199 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Mathematical Physics (2009)  
 Bachelor' degree (1 major) Mathematical Physics (2012)  
 Master's degree (1 major) Mathematics (2010)  
 Master's degree (1 major) Physics (2010)  
 Master's degree (1 major) Physics (2011)  
 Master's degree (1 major) Nanostructure Technology (2011)  
 Master's degree (1 major) Nanostructure Technology (2010)  
 Master's degree (1 major) Mathematical Physics (2012)  
 Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010)  
 Master's degree (1 major) FOKUS Physics (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

Module title		Abbreviation
Renormalization Theory		11-RNT-092-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.
Contents		
Renormalisation group methods for Hamiltonian systems. Partial non-linear differential equations with scaling behaviour for dynamics beyond the equilibrium. Classical-critical and quantum-critical phenomena and their relevance for phase diagrams in cryogenic temperatures. Instability of statistical and dynamic mean-field solutions. Stochastic non-linear partial differential equations. Construction of generating functionals. Halperin-Hohenberg-Ma differential equations. Symmetries, e.g. in the stochastic Burgers' equation (KPZ equation). Introduction and comparison of different RG methods.		
Intended learning outcomes		
The students have gained an overview of renormalisation group methods for non-linear partial differential equations. They know important examples and corresponding solving methods and are able to apply them to specific tasks.		
Courses (type, number of weekly contact hours, language — if other than German)		
R + V (no information on SWS (weekly contact hours) and course language available)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009. Language of assessment: German, English		
Allocation of places		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2010)</p> <p>Bachelor' degree (1 major) Physics (2012)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2009)</p> <p>Bachelor' degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) Mathematics (2012)</p> <p>Master's degree (1 major) Mathematics (2010)</p> <p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) Mathematical Physics (2012)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p> <p>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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor' degree (1 major) Physics (2010) Bachelor' degree (1 major) Physics (2012)		
Master's with 1 major Physics (2010)	JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010	page 207 / 258

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
<b>Module Type 4A Special Training Astronomy</b>		11-SF-4A-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)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Astronomy.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Astronomy.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 8 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 4D Special Training Didactics		11-SF-4D-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Didactics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Didactics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 8 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 4E Special Training Experimental Physics</b>		11-SF-4E-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Experimental Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Experimental Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 8 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 4I Special Training Interdisciplinary Research Fields</b>		11-SF-4I-072-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)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in an interdisciplinary field.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 8 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		



Module title		Abbreviation
<b>Module Type 4T Special Training Theoretical Physics</b>		11-SF-4T-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)
4	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Theoretical Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Theoretical Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 8 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 5A Special Training Astronomy		11-SF-5A-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Astronomy.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Astronomy.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 10 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 5D Special Training Didactics		11-SF-5D-072-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Didactics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Didactics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 10 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 5E Special Training Experimental Physics		11-SF-5E-072-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Experimental Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Experimental Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 10 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 5I Special Training Interdisciplinary Research Fields</b>		11-SF-5I-072-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in an interdisciplinary field.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 10 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 5T Special Training Theoretical Physics</b>		11-SF-5T-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)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Theoretical Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Theoretical Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 10 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 6A Special Training Astronomy		11-SF-6A-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	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Astronomy.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Astronomy.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 12 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 6D Special Training Didactics		11-SF-6D-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Didactics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Didactics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 12 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		



Module title		Abbreviation
Module Type 6E Special Training Experimental Physics		11-SF-6E-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Experimental Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Experimental Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 12 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 6I Special Training Interdisciplinary Research Fields</b>		11-SF-6I-072-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)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in an interdisciplinary field.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 12 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 6T Special Training Theoretical Physics</b>		11-SF-6T-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	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Theoretical Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Theoretical Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 12 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
Module Type 8A Special Training Astronomy		11-SF-8A-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)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Astronomy.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Astronomy.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 16 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

<b>Module title</b>		<b>Abbreviation</b>
<b>Module Type 8D Special Training Didactics</b>		11-SF-8D-072-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
8	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Didactics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Didactics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 16 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 8E Special Training Experimental Physics</b>		11-SF-8E-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Experimental Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Experimental Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 16 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 8I Special Training Interdisciplinary Research Fields</b>		11-SF-8I-072-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	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in an interdisciplinary field.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 16 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (2010) Master's degree (1 major) Nanostructure Technology (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2010) Master's degree (1 major) FOKUS Physics (2010) Master's degree (1 major) FOKUS Physics - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		

Module title		Abbreviation
<b>Module Type 8T Special Training Theoretical Physics</b>		11-SF-8T-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)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
<b>Contents</b>		
Specific, advanced knowledge of one or more of the Faculty's current research areas in the field of Theoretical Physics.		
<b>Intended learning outcomes</b>		
The students have specific and advanced knowledge of one or more current research areas of the faculty in the field of Theoretical Physics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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) talk (approx. 30 minutes) or c) oral examination of one candidate each or oral examination in groups (approx. 30 minutes) or d) project report (approx. 16 pages)		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Physics (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 - Nanostructuring Technology (2006) Master's degree (1 major) FOKUS Physics (2006)		



Module title		Abbreviation
Spintronics		11-SPI-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		
This lecture covers the basic principles of spin transport, with a particular emphasis on the phenomena of giant magnetoresistance and tunnel magnetoresistance. As a last point, we discuss new phenomena from the field of spin dynamics and current-induced spin phenomena.		
Intended learning outcomes		
The students know the basic principles of spin transport models and the applications of spin transport in information technology. They have gained an overview of current findings in this field (giant magnetoresistance, tunnel magnetoresistance).		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 229 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

### Module appears in

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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 (2010)  
 Master's degree (1 major) FOKUS Physics (2011)  
 Master's degree (1 major) FOKUS Physics (2006)

Module title		Abbreviation
<b>Special Theory of Relativity</b>		11-SRT-112-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)
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		
Mathematical principles; differential forms; special relativity; Minkowski space; Lorentz transformation, Hamiltonian equation of motion; relativistic free particle		
Intended learning outcomes		
The students are familiar with the physical concepts and mathematical principles of special relativity. They are familiar with modern mathematical formulation of special relativity. They are able to apply the acquired knowledge to problems of special relativity.		
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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's with 1 major Physics (2010)		
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		page 231 / 258

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 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) FOKUS Physics (2006)

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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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
Thermodynamics and Economics		11-TDO-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		
<p>Energy and economic growth, entropy production, emission reduction. Part I describes the role of energy conversion in the development of the universe, the evolution of life and the unfolding of civilisation. In non-equilibrium thermodynamics, the entropy production density shows the relevance of the second law of thermodynamics for ecological damage and resource consumption. Energy conversion, entropy production and natural resources define the technological and ecological boundaries of industrial economic growth. Part 2 analyses how the factors capital, work, energy and creativity produce the goods and services of a national economy and determine economic growth. The productive power of cheap energy by far exceeds that of expensive labour. Within the current system of taxes and social security contributions, this discrepancy between power and costs of production factors leads to job cuts, waste of resources, impoverishment of nations and growing social tensions. The course discusses how factor income taxation can counteract this development. Part 3 includes seminar presentations, comprises the techniques of rational energy use and non-fossil energy use, and introduces the optimisation programme deeco (Dynamic Energy, Emission and Cost Optimization).</p>		
Intended learning outcomes		
<p>The students understand that energy conversion and entropy production are going to play an important role in the world's economic and social development. As an extension of economic theory, the students know the connections between thermodynamics and economy as well as the productive physical basis of modern economies. They are able to apply the acquired knowledge to particular problems.</p> <p>NOTE: this is the module that was run by Prof. Dr. R. Kümmel, who has now retired. As the module was tailored to his own theory of economy, it has yet to be decided whether we will continue to offer this module.</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>		
Master's with 1 major Physics (2010)		page 235 / 258

<b>Allocation of places</b>
--
<b>Additional information</b>
--
<b>Workload</b>
--
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<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) 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)</p>



Module title		Abbreviation
Thermodynamics and Economics		11-TDOE-141-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)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>Energy and economic growth, entropy production, emission reduction.</p> <p>Part I describes the role of energy conversion in the development of the universe, the evolution of life and the unfolding of civilisation. The entropy production density of non-equilibrium thermodynamics shows the relevance of the second law of thermodynamics for ecological damage and resource consumption. Energy conversion, entropy production and natural resources define the technological and ecological boundaries of industrial economic growth.</p> <p>Part 2 analyses how the factors capital, work, energy and creativity produce the goods and services of a national economy and determine economic growth. The productive power of cheap energy by far exceeds that of expensive labour. Within the current system of taxes and social security contributions, this discrepancy between power and costs of production factors leads to job cuts, waste of resources, impoverishment of nations and growing social tensions. The course discusses how factor income taxation can counteract this development.</p> <p>Part 3 includes seminar presentations, comprises the techniques of rational energy use and non-fossil energy use, and introduces the optimisation programme deeco (Dynamic Energy, Emission and Cost Optimization).</p>		
Intended learning outcomes		
<p>The students understand that energy conversion and entropy production are going to play an important role in the world's economic and social development. As an extension of economic theory, the students know the connections between thermodynamics and economy as well as the productive physical basis of modern economies. They are able to apply the acquired knowledge to particular problems.</p> <p>NOTE: this is the module that was run by Prof. Dr. R. Kümmel, who has now retired. As the module was tailored to his own theory of economy, it has yet to be decided whether we will continue to offer this module.</p>		
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)		
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 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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 (2010)  
 Master's degree (1 major) FOKUS Physics (2011)

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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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
<b>Theoretical Solid State Physics 2</b>		11-TFK2-111-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)
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		
a) metal-insulators and topological insulators b) transport phenomena c) magnetic impurities in metals. Kondo effect and heavy fermions d) electron-phonon interaction e) one-dimensional conductors		
Intended learning outcomes		
The students have advanced knowledge of the theoretical description of solid-state phenomena. They know the mathematical or theoretical methods and are able to apply them to problems of solid-state theory and 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)		
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		
--		
Additional information		
--		
Workload		
--		

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
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 (2010) Master's degree (1 major) FOKUS Physics (2011) Master's degree (1 major) FOKUS Physics (2006)



Module title		Abbreviation
Topology in Solid State Physics		11-TFP-132-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	--
<b>Contents</b>		
The students are familiar with the theory of topological effects in Solid-State Physics. They know the mathematical methods necessary for their description and are able to apply these methods to simple problems.		
<b>Intended learning outcomes</b>		
The students are familiar with the theory of topological effects in Solid-State Physics. They know the mathematical methods necessary for their description and are able to apply these methods to simple problems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V + R (no information on SWS (weekly contact hours) and course language available)		
<b>Method of assessment</b> (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 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		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
--		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
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 (2010) Master's degree (1 major) FOKUS Physics (2011)		

Module title		Abbreviation
Topological Order		11-TOPO-132-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	--
Contents		
<p>In modern Solid-State Physics, the concept of topologically ordered phases plays an increasingly important role. These phases possess no order in the conventional sense of a broken symmetry, but are characterised by topological quantum numbers. Examples of topological quantum numbers or phases include:</p> <ol style="list-style-type: none"> <li>1) The fractional charge and statistics of quasiparticle excitation in quantum Hall fluids.</li> <li>2) The fractional quantisation of spins in spin liquids and the accompanying split-up of spin and charge in anti-ferromagnets.</li> <li>3) The topological anomalies of fractionally quantised systems on the torus (or generally on surfaces with genus <math>g &gt; 0</math>).</li> <li>4) Majorana fermion states at the interfaces between topological superconductors and topologically trivial regions. The lecture explains the fundamental concepts with the help of basic examples.</li> </ol>		
Intended learning outcomes		
The students acquire in-depth knowledge of topological order in quantum condensates.		
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)		
<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) 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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
<p>Master's degree (1 major) Physics (2010)</p> <p>Master's degree (1 major) Physics (2011)</p> <p>Master's degree (1 major) FOKUS Physics (2010)</p> <p>Master's degree (1 major) FOKUS Physics (2011)</p>		

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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 249 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

### 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, Boboliubov-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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		

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

--

**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
<b>Disordered Systems</b>		11-UGS-131-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)
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 semesters.
Contents		
<p>Part 1: Part 1 discusses systems of interacting electrons with random potentials or random interactions with the help of quantum statistical methods which are introduced in a separate lesson. The students learn to calculate transport properties, magnetic instabilities and phase transitions as well as competing orders. Part II: Part II covers non-linear partial differential equations, which also describe systems far beyond equilibrium and systems with random inhomogeneity. Where applicable, exact solubility in a space dimension will be covered; otherwise and in more than one space dimension, diagram methods and renormalisation groups are applied, which will be introduced separately. As a methodological development of the methods of the course Mathematics 3, the path integral method is derived for classical and quantum mechanical models and differential equations (e.g. Feynman-Kac method).</p>		
Intended learning outcomes		
<p>The students acquire insights into the calculability of the behaviour of physical and non-physical models with random parameters. They learn to construct diagram developments for specific models, both for Hamiltonian systems and non-equilibrium differential equations. They understand why physical laws describing the behaviour of non-ordered systems are often times simpler and how a new order arises from disorder. They learn to differentiate between quantum mechanical uncertainty and random uncertainty as well as between disorder and chaos.</p>		
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)		
<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) 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		
--		
Additional information		
--		
Workload		
--		
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010
		page 253 / 258

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

Module title		Abbreviation
<b>Strong Interaction in Accelerator Experiments</b>		11-WWB-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)
3	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		
Asymptomatic freedom/confinement. Hadron production in $e^+/e^-$ collisions. QCD coherence/interference phenomena. QCD Jet simulation. Hadron production in electron-proton collisions. Hadron production in proton-proton collisions.		
Intended learning outcomes		
The students know the basic organisation of QCD processes. They are able to interpret results of accelerator experiments. They have knowledge of methods of data analysis, understand the underlying theories and are able to apply them.		
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		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010
		page 255 / 258

**Module appears in**

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (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) FOKUS Physics (2006)

Module title		Abbreviation
Principles of two- and threedimensional Röntgen imaging		11-ZDR-111-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		
Physics of X-ray generation (X-ray tubes, synchrotron). Physics of the interaction between X-rays and matter (photon absorption, scattering), physics of X-ray detection. Mathematics of reconstruction algorithms (filtered rear projection, Fourier reconstruction, iterative methods). Image processing (image data pre-processing, feature extraction, visualisation,...). Applications of X-ray imaging in the industrial sector (component testing, material characterisation, metrology, biology, ...). Radiation protection and biological radiation effect (dose, ...).		
Intended learning outcomes		
The students know the principles of generating X-rays and of their interactions with matter. They know imaging techniques using X-rays and methods of image processing as well as application areas of these methods.		
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.		
Allocation of places		
--		
Additional information		
--		
Workload		
--		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Master's with 1 major Physics (2010)		page 257 / 258
JMU Würzburg • generated 26-Aug-2024 • exam. reg. data record Master (120 ECTS) Physik - 2010		

### Module appears in

Bachelor' degree (1 major) Physics (2010)  
 Bachelor' degree (1 major) Physics (2012)  
 Bachelor' degree (1 major) Nanostructure Technology (2010)  
 Bachelor' degree (1 major) Nanostructure Technology (2012)  
 Master's degree (1 major) 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 (2010)  
 Master's degree (1 major) FOKUS Physics (2011)  
 Master's degree (1 major) Functional Materials (2012)  
 Master's degree (1 major) FOKUS Physics (2006)