

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: 2016 Responsible: Faculty of Physics and Astronomy

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record 88|128|-|-|H|2016

Learning Outcomes

German contents and learning outcome available but not translated yet.

Nach erfolgreichem Abschluss des Studiums verfügen die Absolventinnen und Absolventen über die folgenden Kompetenzen:

- Die Absolventen bzw. Absolventinnen besitzen hohes Abstraktionsvermögen, die Fähigkeit zu analytischem Denken, hohe Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventen bzw. Absolventinnen verfügen über einen breiten Überblick über die Teilgebiete der Physik und interdisziplinäre Zusammenhänge.
- Sie verfügen über vertiefte Kenntnisse der mathematischen und theoretischen Grundlagen der Physik sowie fundiertes Wissen über die theoretischen und experimentellen Methoden zur Erlangung neuer Erkenntnisse.
- Sie sind in der Lage, ihre Fähigkeiten und Kenntnisse in Projekten umzusetzen und verfügen über Kenntnisse des aktuellen Forschungsstandes in mindestens einem Spezialgebiet der Physik.
- Sie sind in der Lage, sich anhand von Primärliteratur, insbesondere in englischer Sprache, in den aktuellen Forschungsstand eines Spezialgebiets einzuarbeiten
- Sie sind in der Lage, physikalische und mathematische Methoden selbstständig auf konkrete experimentelle oder theoretische physikalische Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten.
- Sie sind in der Lage, auch bei unvollständig vorliegenden Informationen physikalische Probleme unter Anwendung der wissenschaftlichen Arbeitsweise und unter Beachtung der Regeln guter wissenschaftlicher Praxis selbstständig zu bearbeiten und die Ergebnisse und Folgen ihrer Arbeit darzustellen, zu bewerten und zu vertreten.
- Sie sind in der Lage, mit Fachvertretern auf dem aktuellen Stand der Forschung physikalische Fragestellungen zu diskutieren und auch Nichtwissenschaftlern physikalische Zusammenhänge zu erläutern.
- Sie besitzen die Fähigkeit, als Physiker bzw. Physikerin in interdisziplinär und international zusammengesetzten Teams aus (Natur-) Wissenschaftlern bzw. (Natur-) Wissenschaftlerinnen und/oder Ingenieuren bzw. Ingenieurinnen in Forschung, Industrie und Wirtschaft mitzuwirken oder diese zu leiten.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen verfügen über vertiefte Kenntnisse der mathematischen, experimentellen und theoretischen Grundlagen der Physik.
- Die Absolventinnen und Absolventen können auf ein fundiertes Wissen über die theoretischen und experimentellen Methoden zur Erlangung neuer Erkenntnisse zurückgreifen.
- Die Absolventen bzw. Absolventinnen verfügen über einen breiten Überblick über die Teilgebiete der Physik.
- Die Absolventen und Absolventinnen kennen angrenzende Gebiete der Physik und erkennen interdisziplinäre Zusammenhänge.
- Die Absolventinnen und Absolventen besitzen hohes Abstraktionsvermögen, analytisches Denken, hohe Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen wenden ihre Fähigkeiten und Kenntnisse in Projekten an und verfügen über Kenntnisse des aktuellen Forschungsstandes in mindestens einem Spezialgebiet der Physik.
- Die Absolventinnen und Absolventen sind in der Lage, mit Fachvertretern auf dem aktuellen Stand der Forschung physikalische Fragestellungen zu diskutieren.

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- Die Absolventinnen und Absolventen sind in der Lage, physikalische und mathematische Methoden selbstständig auf konkrete experimentelle oder theoretische physikalische Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten.
- Die Absolventinnen und Absolventen sind in der Lage, sich anhand von Primärliteratur, insbesondere in englischer Sprache, in den aktuellen Forschungsstand eines Spezialgebiets einzuarbeiten.

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind in der Lage, auch bei unvollständig vorliegenden Informationen physikalische Probleme wissenschaftlich und unter Beachtung der Regeln guter wissenschaftlicher Praxis selbstständig zu bearbeiten und die Ergebnisse und Folgen ihrer Arbeit darzustellen, zu bewerten und zu vertreten.
- Die Absolventinnen und Absolventen besitzen die Fähigkeit, als Physiker bzw. Physikerin in interdisziplinär und international zusammengesetzten Teams aus (Natur-) Wissenschaftlern bzw. (Natur-) Wissenschaftlerinnen und/oder Ingenieuren bzw. Ingenieurinnen in Forschung, Industrie und Wirtschaft mitzuwirken oder diese zu leiten.
- Die Absolventinnen und Absolventen sind in der Lage, physikalische und mathematische Methoden selbstständig auf konkrete experimentelle oder theoretische physikalische Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Fähigkeiten und Kenntnisse in Projekten umzusetzen und verfügen über Kenntnisse des aktuellen Forschungsstandes in mindestens einem Spezialgebiet der Physik.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind in der Lage, auch bei unvollständig vorliegenden Informationen physikalische Probleme wissenschaftlich selbstständig zu bearbeiten und die Ergebnisse und Folgen ihrer Arbeit darzustellen, zu bewerten und zu vertreten.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und beachten sie.

Befähigung zum gesellschaftlichen Engagement

- Die Absolventinnen und Absolventen können naturwissenschaftliche Entwicklungen kritisch reflektieren und deren Auswirkungen auf die Wirtschaft, Gesellschaft und die Umwelt erfassen. (Technikfolgenabschätzung).
- Die Absolventinnen und Absolventen haben ihr Wissen bezüglich wirtschaftlicher, gesellschaftlicher, naturwissenschaftlicher, kultureller etc. Fragestellungen erweitert und können begründet Position beziehen.
- Die Absolventinnen und Absolventen sind in der Lage auf dem aktuellen Stand der Forschung physikalische Fragestellungen zu diskutieren und Nichtwissenschaftlern physikalische Zusammenhänge zu erläutern.
- Die Absolventinnen und Absolventen haben die Bereitschaft und Fähigkeit entwickelt, ihre Kompetenzen in partizipative Prozesse einzubringen und aktiv an Entscheidungen mitzuwirken.

Master's with 1 major Physics (2016))
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Abbreviations used

Course types: \mathbf{E} = field trip, \mathbf{K} = colloquium, \mathbf{O} = conversatorium, \mathbf{P} = placement/lab course, \mathbf{R} = project, \mathbf{S} = seminar, \mathbf{T} = tutorial, $\ddot{\mathbf{U}}$ = exercise, \mathbf{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:

ASPO2015

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

13-Apr-2016 (2016-68) except for mandatory elective 11-SSC-172 added in Fast Track procedure at a later time

14-Mar-2018 (2018-17)

12-Jun-2024 (2024-76)

14-Nov-2024 (2024-96)

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.

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In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

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The subject is divided into

Abbreviation	Module title	ECTS credits	Method of grading	pag
Compulsory Electives (6o	ECTS credits)			
Subfield Physics (55 EC	rs credits)			
Advanced Laboratory (Course (9 ECTS credits)			
11-P-FM1-161-m01	Advanced Laboratory Course Master Part 1	3	B/NB	159
11-P-FM2-161-m01	Advanced Laboratory Course Master Part 2	3	B/NB	16
11-P-FM3-161-m01	Advanced Laboratory Course Master Part 3	3	B/NB	16
11-P-FM4-161-m01	Advanced Laboratory Course Master Part 4	3	B/NB	16
Advanced Seminar (5 E	CTS credits)			
11-OSP-A-161-m01	Advanced Seminar Physics A	5	NUM	15
11-0SP-B-161-m01	Advanced Seminar Physics B	5	NUM	15
Experimental Physics	10 ECTS credits)			
11-BSV-161-m01	Image and Signal Processing in Physics	6	NUM	74
11-QUI-161-m01	Quantum Information Technology	6	NUM	17
11-OHL-161-m01	Organic Semiconductors	6	NUM	15
11-PMM-161-m01	Physics of Advanced Materials	6	NUM	16
11-SPI-161-m01	Spintronics	6	NUM	18
11-BMT-161-m01	Biophysical Measurement Technology in Medical Science	6	NUM	7
11-FK2-161-m01	Solid State Physics 2	8	NUM	11
11-FKS-161-m01	Solid State Spectrocopy	6	NUM	11
11-MAG-161-m01	Magnetism	6	NUM	13
11-HLPH-161-m01	Semiconductor Physics	6	NUM	13
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	13
11-QTH-161-m01	Quantum Transport	6	NUM	17
11-NOP-161-m01	Nano-Optics	6	NUM	15
11-NDS-161-m01	Low Dimensional Structures	6	NUM	14
11-SUP-161-m01	Superconductivity	6	NUM	19
08-PCM4-161-m01	Ultrafast spectroscopy and quantum-control	5	NUM	1
	Advanced Topics in Solid State Physics	6	NUM	8
11-ASM-161-m01	Methods of Observational Astronomy	6	NUM	6
11-TPE-161-m01	Experimental Particle Physics	6	NUM	21
11-ASP-161-m01	Introduction to Space Physics	6	NUM	6:
11-MAS-161-m01	Multi-wavelength Astronomy	6	NUM	14
11-CSAM-161-m01	Advanced Topics in Astrophysics	6	NUM	8
11-MRI-171-m01	Advanced Magnetic Resonance Imaging	6	NUM	14
, 11-SSC-172-m01	Surface Science	6	NUM	18
11-FPA-161-m01	Visiting Research	10	NUM	12
11-EXE5-161-m01	Current Topics in Experimental Physics	5	NUM	9
11-EXE6-161-m01	Current Topics in Experimental Physics	6	NUM	94
11-EXE7-161-m01	Current Topics in Experimental Physics	7	NUM	98
11-EXE8-161-m01	Current Topics in Experimental Physics	8	NUM	10
11-EXE6A-161-mo1	Current Topics in Experimental Physics	6	NUM	9
11-EXP6-161-m01	Current Topics in Physik	6	NUM	10
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Theory of Physics (10 E	1			1
11-QM2-161-m01	Quantum Mechanics II	8	NUM	171
11-RTT-161-m01	Theory of Relativity	6	NUM	183
11-QVTP-161-m01	Many Body Quantum Theory	8	NUM	177
11-RMFT-161-m01	Renormalization Group Methods in Field Theory	8	NUM	179
11-PKS-161-m01	Physics of Complex Systems	6	NUM	16
11-QIC-161-m01	Quantum Information and Quantum Computing	6	NUM	169
11-TDO-161-m01	Thermodynamics and Economics	6	B/NB	19
11-TFK-161-m01	Theoretical Solid State Physics	8	NUM	20
11-TFK2-161-m01	Theoretical Solid State Physics 2	8	NUM	20
11-FTFK-161-m01	Field Theory in Solid State Physics	8	NUM	12
11-TOPO-161-m01	Topological Order	6	NUM	20
11-TFP-161-m01	Topology in Solid State Physics	6	NUM	20
11-TSL-161-m01	Theory of Superconductivity	6	NUM	21
11-CMS-161-m01	Computational Materials Science (DFT)	8	NUM	78
11-KFT-161-m01	Conformal Field Theory	6	NUM	13
11-KFT2-161-m01	Conformal Field Theory 2	6	NUM	13
11-MSF-161-m01	Magnetism and Spin Fluids	6	NUM	14
11-TQP-161-m01	Topological Quantum Physics	6	NUM	21
11-CRP-161-m01	Renormalization Group and Critical Phenomena	6	NUM	8
11-BWW-161-m01	Bosonisation and Interactions in One Dimension	6	NUM	7
11-EIT-161-m01	Gauge Theories	6	NUM	8
11-GGD-161-m01	Introduction to Gauge/Gravity Duality	8	NUM	12
11-EFQ-161-m01	Introduction to Fractional Quantisation	6	NUM	8
11-TEF-161-m01	Topological Effects in Electronic Systems	6	NUM	19
11-FTAS-161-m01	Field Theoretical Aspects of Solid State Physics	6	NUM	12
11-AKM-161-m01	Cosmology	6	NUM	54
11-AST-161-m01	Theoretical Astrophysics	6	NUM	6.
11-EPP-161-m01	Introduction to Plasma Physics	6	NUM	9
11-APL-161-m01	High Energy Astrophysics	6	NUM	5
11-NMA-161-m01	Computational Astrophysics	6	NUM	15
11-RQFT-161-m01	Relativistic Quantum Field Theory	8	NUM	18
11-QFT2-161-m01	Quantum Field Theory II	8	NUM	16
11-TEP-161-m01	Theoretical Elementary Particle Physics	8	NUM	20
11-ATTP-161-m01	Selected Topics of Theoretical Elementary Particle Physics	6	NUM	6
11-BSM-161-m01	Models Beyond the Standard Model of Elementary Particle Physics	6	NUM	7
11-STRG1-171-m01	String Theory 1	8	NUM	19
11-STRG2-171-m01	String Theory 2	6	NUM	-
11-FPA-161-mo1	Visiting Research	10	NUM	19 12
11-EXT5-161-m01	Current Topics of Theoretical Physics		NUM	
11-EXT6-161-m01	Current Topics of Theoretical Physics	5	NUM	10
				10
11-EXT7-161-m01	Current Topics of Theoretical Physics	7	NUM	11
11-EXT8-161-m01	Current Topics of Theoretical Physics	8	NUM	11
	Current Topics of Theoretical Physics	6	NUM	11
11-EXT6A-161-m01				
11-EXT6A-161-m01 11-EXP6A-161-m01 ter's with 1 major Physics (2016)	Current Topics in Physik JMU Würzburg • generated 19-Apr-2025 • e	6	NUM	10

11-SLQ-232-m01	Black Holes	6	NUM	185
11-APM-242-m01	Astrophysics	6	NUM	58
11-ATP-242-m01	Atmospheric Physics	6	NUM	66
11-0QS-242-m01	Open Quantum Systems	6	NUM	156
Subfield Non-physical M	inor			
10-M-ORSaf-152-m01	Operations Research for students of other subjects	10	NUM	52
10-M-VAN-152-m01	Advanced Analysis	7	NUM	53
10-M=AAAN-161-m01	Applied Analysis	10	NUM	26
10-M=ADGM-161-m01	Differential Geometry	10	NUM	28
10-M=AFTH-161-m01	Complex Analysis	10	NUM	30
10-M=ALTH-161-m01	Lie Theory	10	NUM	32
10-M=ATOP-161-m01	Тороlogy	10	NUM	34
10-M=AZTH-161-m01	Number Theory	10	NUM	36
10-M=VGDS-161-m01	Groups and their Representations	10	NUM	40
10-M=VGEM-161-m01	Geometrical Mechanics	10	NUM	42
10-M=VNPE-161-m01	Numeric of Partial Differential Equations	10	NUM	46
10-M=VDIM-161-m01	Discrete Mathematics	5	NUM	38
10-M=VMPH-161-m01	Selected Topics in Mathematical Physics	10	NUM	44
10-M=VPDP-161-m01	Partial Differential Equations of Mathematical Physics	10	NUM	48
10-M=VPRG-161-m01	Pseudo Riemannian and Riemannian Geometry	10	NUM	50
10-I-DB-152-m01	Databases	5	NUM	21
10-I=DB-161-m01	Databases	5	NUM	15
10-I=PA-161-m01	Analysis and Design of Programs	5	NUM	18
10-I-RAK-152-m01	Computer Architecture	5	NUM	24
10-I-00P-152-m01	Object oriented Programming	5	NUM	23
10-I-BS-152-m01	Operating Systems	5	NUM	20
10-I=Kl1-161-m01	Artificial Intelligence 1	5	NUM	16
08-FU-SAM-161-m01	Sensor and Actor Materials - Functional Ceramics and Magne- tic Particles	5	NUM	12
08-FU-EEW-152-m01	Electrochemical Energy Storage and Conversion	5	NUM	9
08-FU-MW-161-m01	Structure and Properties of Modern Materials: Experiments vs. Simulations	5	NUM	11
11-EXNP6-161-m01	Nonphysical Minor Subject	6	NUM	102
Thesis (60 ECTS credits)			I	
11-FS-P-161-m01	Professional Specialization Physics	15	B/NB	122
11-MP-P-161-m01	Scientific Methods and Project Management Physics	15	B/NB	14
11-MA-P-161-m01	Master Thesis Physics	30	NUM	140

Module					Abbreviation	
Electrochemical Energy Storage and Conversion			Conversion		08-FU-EEW-152-mo	1
Module coordinator				Module offered by	<u> </u>	
			ology of Material Syn-		echnology of Materi	al Synthesis
thesis			otogy of matchat Jyll-	chair of chemical I	connotogy of materia	at Synthesis
ECTS	Method	ofgrading	Only after succ. con	pl. of module(s)		
5	numeric			• • • •		
Duratio	on M	odule level	Other prerequisites			
1 seme	· · ·	ndergraduate				
Conten	its					
um and cal dou	d nickel m uble layer	etal hydride, sodium capacitors, redox-flov	systems (aqueous and sulphur, sodium nicko v batteries, fuel cell sy solar cell), thermoelec	el chloride, lithium io stems (AFC, PEMFC,	on accumulators), el	ectrochemi-
		goutcomes				
Studen	nts have d		e of electrochemical e	nergy storage and c	onversion and are at	ole to apply
				if other than Corma		
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	P (1) + E (
			anguage — if other tha can be chosen to earn		tion offered — if not	every seme-
Assess	-	essment: German and red: Once a year, sun ces	· •			
Additio	onal inforr	nation	<u>.</u>			
Worklo	ad					
150 h						
-	ng cycle					
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	-	(1 major) Functional I				
			ire Technology (2020)			
	-	(1 major) Physics (20				
	-	(1 major) Physics Inte				
Master	's degree	(1 major) Quantum Er	ngineering (2020)			
Bachel	or's degre	e (1 major) Nanostru	cture Technology (202	o)		
Bachel	or's degre	ee (1 major) Quantum	Technology (2021)			
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Master's degree (1 major) Quantum Technology (2021)

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	e title				Abbreviation
Structu	ire and	Properties of Modern M	Aaterials: Experiments	s vs. Simulations	08-FU-MW-161-m01
Module	e coord	linator		Module offered by	
		mme coordinator Funkt	ionsworkstoffa (Euros	· · ·	 Technology of Material Synthesi
tional I				chair of chemicat	
ECTS		od of grading	Only after succ. con	npl. of module(s)	
5 numerical grade					
Duratio	on	Module level	Other prerequisites	i	
1 seme	ster	graduate			
Conten	Its				
Materia simula		erties of metals and cera	amics: correlation of s	tructure/property re	lations through experiments and
Intend	ed lear	ning outcomes			
mance	ceram pecial	ics. They are introduced	to measuring method	s and calculation m	uminium alloys and high-perfor- ethods using numerical simulat of materials and the resulting pro
Course	s (type	, number of weekly cont	act hours, language –	- if other than Germ	an)
V (2) +					
c) oral Langua Assess	examir age of a ment c	nation of one candidate nation in groups (groups nssessment: German and offered: Once a year, win	of 2, approx. 30 minu d/or English	-	
All f					
Allocal	lon of	places			
			-		
		places			
 Additic	onal inf				
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 Additic 150 h Teachin Referre Module	onal inf oad ng cycl ed to in e appea	e LPOI (examination reg	16))
 Additio Worklo 150 h Teachi Referre Modulo Master Master	onal inf oad ng cycl ed to in e appea 's degr	e LPOI (examination reg ars in ee (1 major) Physics (20	16) ure Technology (2016))
 Additic 150 h Teachin Referre Module Master Master Master	onal inf oad ng cycl ed to in e appea 's degr 's degr 's degr	e LPOI (examination reg ars in ree (1 major) Physics (20 ee (1 major) Nanostructu	16) ure Technology (2016) Materials (2016))
 Additic Worklo 150 h Teachin Referre Module Master Master Master Master	onal inf oad ng cycl ed to in e appea 's degr 's degr 's degr	e LPOI (examination reg ars in ee (1 major) Physics (20 ee (1 major) Nanostructu ee (1 major) Functional I	16) ure Technology (2016) Materials (2016) ure Technology (2020))
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Module	e title				Abbreviation
Sensor	Sensor and Actor Materials - Functional Ceramics and Mag			netic Particles	08-FU-SAM-161-m01
Module coordinator				Module offered b	by
degree tional <i>N</i>		mme coordinator Funktic	onswerkstoffe (Func-	Chair of Chemica	l Technology of Material Synthesis
ECTS	Meth	od of grading	Only after succ. con	pl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
					as piezoelectrics, shape memory cological fluids, magnetofluids.
Intend	ed lear	ning outcomes			
Studen	its have	e developed fundamenta	l knowledge in the ar	ea of sensory and	actuatory materials.
Course	s (type	, number of weekly conta	act hours, language –	- if other than Ger	man)
V (2) +		· · · · ·			
Metho	d of as	sessment (type, scope, la ion on whether module c			nation offered — if not every seme
	itable f	ffered: Once a year, sum for bonus places			
Additio	onal inf	ormation			
Worklo	ad				
150 h					
Teachi	ng cycl	e			
 Referre	d to in	LPOI (examination regu	lations for teaching	legree programm	
Module	anne	ars in			
Module Master			6)		
Master	's degr	ee (1 major) Physics (201			
Master Master	's degr 's degr		re Technology (2016)		
Master Master Master Master	's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Functional M ee (1 major) Nanostructu	re Technology (2016) laterials (2016) re Technology (2020)		
Master Master Master Master Master	's degr 's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Functional M ee (1 major) Nanostructu ee (1 major) Physics (202	re Technology (2016) laterials (2016) re Technology (2020) 20)		
Master Master Master Master Master Master	's degr 's degr 's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Functional M ee (1 major) Nanostructu ee (1 major) Physics (202 ee (1 major) Physics Inter	re Technology (2016) laterials (2016) re Technology (2020) 20) rnational (2020)		
Master Master Master Master Master Master	's degr 's degr 's degr 's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Functional M ee (1 major) Nanostructu ee (1 major) Physics (202 ee (1 major) Physics Inter ee (1 major) Quantum En	re Technology (2016) laterials (2016) re Technology (2020) co) mational (2020) gineering (2020)		
Master Master Master Master Master Master Master	's degr 's degr 's degr 's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Functional M ee (1 major) Nanostructu ee (1 major) Physics (202 ee (1 major) Physics Inter	re Technology (2016) laterials (2016) re Technology (2020) co) mational (2020) gineering (2020) chnology (2021)		

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.
	reg. data record Master (120 ECTS) Physik - 2016

Module ti	tle			Abbreviation		
Ultrafast	spectroscopy and quantum	-control	·	08-PCM4-161-m01		
Madulaa			Madula offered by	·		
	oordinator		Module offered by			
	f the seminar "Nanoskalige				emistry	
	lethod of grading	Only after succ. con	npl. of module(s)			
-	umerical grade					
Duration	Module level	Other prerequisites				
1 semeste	er graduate	Prior completion of	modules o8-PCM1a a	and o8-PCM1b recon	nmended.	
Contents						
	ule discusses advanced top ses, time-resolved laser spe			control. It focuses o	n ultrashort	
Intended	learning outcomes					
plain the	are able to describe the ge theory of time-resolved las and applications of quant	er spectroscopy and na				
Courses (type, number of weekly cor	itact hours, language –	- if other than Germa	ın)		
S (2) + Ü	(1)					
Module ta	aught in: German or English					
	f assessment (type, scope, mation on whether module			tion offered — if not	every seme-	
c) talk (ap Language	amination of one candidate oprox. 30 minutes) of assessment: German ar n of places					
Additiona	l information					
Additiona	IL INFORMATION					
Workload						
150 h						
Teaching	cycle					
Referred	to in LPO I (examination re	gulations for teaching-	degree programmes)			
Module a	ppears in					
	degree (1 major) Chemistry	(2016)				
	degree (1 major) Mathemat					
	degree (1 major) Physics (2					
Master's degree (1 major) Nanostructure Technology (2016)						
Master's degree (1 major) Ranostracture recimology (2016) Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Chemistry (2018)						
Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						
	degree (1 major) Nanostruc					
Master's	degree (1 major) Physics (2	020)				
Master's with	ı major Physics (2016)	JMU Würzb	urg • generated 19-Apr-2025 •	• exam.	page 13 / 215	
viaster s with					1.0. 57 5	



Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 14 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title					Abbreviation	
Databa	Databases 10-I=DB-161-m01					
Modul	e coord	inator		Module offered by		
			ve Caianaa)	-		
		es Informatik (Compute	-	Institute of Comput	erScience	
ECTS	1	od of grading rical grade	Only after succ. con	npl. of module(s)		
5						
Duration 1 seme		Module level graduate	Other prerequisites	i		
Conter		glaudate				
		abra and complex SOL		planning and norma	l forme XML data m	adalling
	-	anagement.			tionis, Ame data in	Juetting,
Intend	ed lear	ning outcomes				
		oossess knowledge ab g in XML.	out data modelling and	l queries in SQL, trar	nsactions as well as	about easy
Course	es (type	, number of weekly cor	itact hours, language –	- if other than Germa	ın)	
V (2) +	_					
			language — if other th can be chosen to earn		tion offered — if not	every seme-
		nation (approx. 60 to 1				
			eginning of the course,	the written examina	tion may be replace	d bv an oral
			approx. 20 minutes) or			
		es per candidate).				
		en examination for Ma				
	age of a Ible for	ssessment: German ar	id/or English			
	tion of p					
		Jaces				
Additio	onal inf	ormation				
Focuse	es availa		Master's programme I	nformatik (Compute	r Science, 120 ECTS (credits): SE,
IS, HCI			_			
Worklo	pad					
150 h	_					
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
Modul	e appea	irs in				
Master	r's degr	ee (1 major) Computer	Science (2016)			
Master's degree (1 major) Physics (2016)						
Master's degree (1 major) Digital Humanities (2016)						
Master's degree (1 major) Computer Science (2017)						
Master's degree (1 major) Computer Science (2018)						
Master's degree (1 major) Physics (2020)						
Master's degree (1 major) Physics International (2020)						
Master's degree (1 major) Quantum Engineering (2020)						
Master's degree (1 major) Quantum Engineering (2024)						
Master	's degr	ee (1 major) Physics Int	ernational (2024)			
Master's w	ith 1 majo	Physics (2016)	JMU Würzb	urg • generated 19-Apr-2025	• exam.	page 15 / 215
				cord Master (120 ECTS) Physi		

Module title					Abbreviation		
Artifici	Artificial Intelligence 1 10-I=KI1-161-m01						
Module coordinator				Module offered by			
holder	of the (Chair of Computer Scie	nce VI	Institute of Comput	er Science		
ECTS		od of grading	Only after succ. con				
5	1	rical grade		• • • •			
Durati	on	Module level	Other prerequisites	6			
1 seme	ester	graduate					
Conter	nts						
			euristic search, constra d inference, knowledge		, search with partial	information,	
Intend	ed lear	ning outcomes					
			d practical knowledge a ess possible applicatio		gence in the area of	agents,	
		-	ntact hours, language –		n)		
V (2) +		,			,		
Metho	d of ass	sessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-	
ster, in	Iformati	on on whether module	e can be chosen to earn	a bonus)			
lf anno examir	ounced nation c		20 minutes). eginning of the course, (approx. 20 minutes) or				
		ssessment: German ar	nd/or English				
	ble for						
Alloca	tion of p	olaces					
Additio	onal inf	ormation					
Focuse AT,SE,		able for students of the	e Master's programme I	nformatik (Computer	r Science, 120 ECTS o	credits):	
Worklo							
150 h							
_	ng cycl	e					
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)			
Modul	e appea	ars in					
Master	r's degr	ee (1 major) Computer	Science (2016)				
1	-	ee (1 major) Mathemat					
Master's degree (1 major) Physics (2016)							
Master's degree (1 major) Nanostructure Technology (2016)							
Master's degree (1 major) Computational Mathematics (2016)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)							
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Computational Mathematics (2019)							
	Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)						
	-						
waster's w	ntn 1 majo	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 16 / 215	

Master's degree (1 major) Information Systems (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Aerospace Computer Science (2020)

Master's degree (1 major) Physics International (2020)

Master's degree (1 major) Quantum Engineering (2020)

Master's degree (1 major) Quantum Technology (2021)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 17 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation		
Analys	Analysis and Design of Programs 10-I=PA-161-m01					
Modul	e coord	inator		Module offered by	<u> </u>	
holder	of the (Chair of Computer Scie	nce II	Institute of Comput	er Science	
ECTS		od of grading	Only after succ. con			
5		rical grade		,		
Durati	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts					
Progra	m analy	sis, model creation in	software engineering, J	program quality, test	of programs, proces	ss models.
Intend	ed learı	ning outcomes				
The stu quality		are able to analyse pro	grams, to use testing fr	ameworks and metri	ics as well as to judg	e program
		number of weekly cor	itact hours, language –	- if other than Germa	n)	
V (2) +		, <u>, , , , , , , , , , , , , , , , , , </u>				
	_	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	everv seme-
			can be chosen to earn			every serie
written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus						
Alloca	tion of p	olaces				
Additio	onal inf	ormation				
Focuse SE,IS,E		able for students of the	e Master's programme I	nformatik (Compute	r Science, 120 ECTS (credits):
Worklo	ad					
150 h						
	ng cycl	9				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
Modul	e appea	rs in				
		ee (1 major) Computer	Science (2016)			
	-	ee (1 major) Mathemat				
	-	ee (1 major) Physics (2				
Master's degree (1 major) Nanostructure Technology (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computer Science (2017)						
Master's degree (1 major) Computer Science (2018)						
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2010)						
Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)						
·						
Master's w	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 cord Master (120 ECTS) Physi		page 18 / 215

Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 19 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Modul	e title				Abbreviation
Operat	ting Sys	stems			10-I-BS-152-m01
Modul	e coord	inator		Module offered by	<u> </u>
		Chair of Computer Scienc	e ll	Institute of Comput	er Science
ECTS		od of grading	Only after succ. com		
5		rical grade			
Duratio		Module level	Other prerequisites		
1 seme		undergraduate			
Conter					
Introdu sing in	uction to operat		nd threads, CPU sche	eduling, synchronisa	ure principles, interrupt proces- ation and communication, memo-
Intend	ed lear	ning outcomes			
The stu	udents (possess knowledge and p	practical skills in buil	ding and using esse	ntial parts of operating systems.
Course	es (type	, number of weekly conta	ct hours, language —	· if other than Germa	an)
V (2) +					
Metho	d of ass	sessment (type, scope, la on on whether module ca			ition offered — if not every seme-
Langua credita	age of a Ible for		or English		
Allocat	tion of p	olaces			
Additio	onal inf	ormation			
Worklo	oad				
150 h					
Teachi	ng cycl	е			
Referre	ed to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Modul	e appea	nrs in			
Bachel	lor's de	gree (1 major) Computer S	Science (2015)		
Bachelor's degree (1 major) Mathematics (2015)					
Bachelor's degree (1 major) Computational Mathematics (2015)					
Bachelor's degree (1 major) Aerospace Computer Science (2015)					
		ee (1 major) Physics (2010			
	-	ee (1 major) Nanostructur gree (1 major) Aerospace		017)	
		gree (1 major) Computer S	•	.01/)	
200100					

Module title				Abbreviation	
Databases 10-I-DB-152-m01					
Modul	e coordinator		Module offered by	<u> </u>	
Dean c	of Studies Informatik (Comput	er Science)	Institute of Comput	er Science	
ECTS	Method of grading	Only after succ. cor			
5	numerical grade				
Duratio		Other prerequisites			
1 seme			•		
Conter					
	onal algebra and complex SQL	statements: database	planning and norma	l forms: transaction	manage-
ment.					
Intend	ed learning outcomes				
The stu	udents possess knowledge ab	out database modellin	g and queries in SQL	as well as transacti	ons.
Course	es (type, number of weekly con	ntact hours, language -	- if other than Germa	ın)	
V (2) +				·	
	d of assessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
	formation on whether module				every serie
writter	n examination (approx. 60 to 1	20 minutes).			
	ounced by the lecturer at the b				
	nation of one candidate each	(approx. 20 minutes) o	r an oral examination	i in groups of 2 cand	idates (ap-
	5 minutes per candidate).	ad / or English			
-	age of assessment: German a able for bonus	Id/of English			
	tion of places				
Additio	onal information				
	· · · · · · · · · · · · · · · · · · ·				
Worklo	bad				
150 h					
	ng cycle				
Referre	ed to in LPO I (examination re	gulations for teaching-	degree programmes)		
§ 49		<u></u>			
§ 69					
Modul	e appears in				
Bache	lor's degree (1 major) Compute	er Science (2015)			
Bache	lor's degree (1 major) Mathem	atics (2015)			
Bache	lor's degree (1 major) Busines	s Information Systems	(2015)		
Bachelor's degree (1 major) Computational Mathematics (2015)					
Bachelor's degree (1 major) Aerospace Computer Science (2015)					
Bachelor's degree (1 major) Functional Materials (2015)					
First state examination for the teaching degree Realschule Computer Science (2015)					
First state examination for the teaching degree Gymnasium Computer Science (2015)					
Master's degree (1 major) Physics (2016)					
Bachelor's degree (1 major) Business Information Systems (2016)					
Bachelor's degree (1 major) Aerospace Computer Science (2017)					
Bache	lor's degree (1 major) Compute	er Science (2017)			
Master's w	vith 1 major Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physi		page 21 / 215

Bachelor's degree (1 major) Computer Science (2019) Bachelor's degree (1 major) Business Information Systems (2019) Bachelor's degree (1 major) Business Information Systems (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Bachelor's degree (1 major) Business Information Systems (2021) Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Business Information Systems (2023) Bachelor's degree (1 major) Business Information Systems (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Games Engineering (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 22 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation		
Object	Object oriented Programming 10-I-OOP-152-m01					
Module coordinator				Module offered by		
Dean o	of Studie	es Informatik (Compute	er Science)	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5		rical grade		,		
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conter	Its					
Polymo ment.	orphism	, generic programming	, meta programming, v	veb programming, te	mplates, document	manage-
Intend	ed learı	ning outcomes				
	idents a ractical	are proficient in the diff use.	erent paradigms of ob	ject-oriented prograr	nming and have exp	erience in
· ·		, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (2) +		,				
		essment (type, scope,	 language — if other th	an German, examina	tion offered — if not	every seme-
ster, in	formati	on on whether module	can be chosen to earn			
lf anno examir prox. 1 Langua	unced l nation o 5 minut	nation (approx. 60 to 12 by the lecturer at the be f one candidate each (es per candidate). ssessment: German an bonus	eginning of the course, approx. 20 minutes) or			
	ion of p					
Additio	nal inf	ormation				
Worklo	ad					
150 h						
	ng cycl	e				
		-				
Referre	d to in	LPOI (examination reg		degree programmes)		
	Nr. 3 b)					
	e appea	ve in				
		gree (1 major) Compute	r Science (2015)			
		gree (1 major) Compute				
		gree (1 major) Business		(2015)		
		gree (1 major) Computa	•	-		
Bachelor's degree (1 major) Aerospace Computer Science (2015)						
First state examination for the teaching degree Gymnasium Computer Science (2015)						
Master's degree (1 major) Physics (2016)						
Master's degree (1 major) Nanostructure Technology (2016)						
Bachelor's degree (1 major) Business Information Systems (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Bachelor's degree (1 major) Business Information Systems (2019)						
Bachel	or's de	gree (1 major) Business	information Systems	(2019)		
Master's w	ith 1 majoı	Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physil		page 23 / 215

Module title				Abbreviation		
Compu	Computer Architecture 10-I-RAK-152-m01					
Module coordinator				Module offered by		
Dean c	of Studio	es Informatik (Compute	er Science)	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ester	undergraduate				
Conter	-					
		t architectures, comma rector processors, mult		pipelining, statical a	and dynamic instruct	tion schedu-
Intend	ed lear	ning outcomes				
		master the most impor operating systems.	ant techniques to desi	gn fast computers as	s well as their intera	ction with
Course	es (type	, number of weekly cor	tact hours, language –	- if other than Germa	ın)	
V (2) +		,	, , , , , , , , , , , , , , , , , , , ,		,	
		e ssment (type, scope, on on whether module			tion offered — if not	every seme-
lf anno examir prox. 1 Langua	ounced nation c 5 minut	nation (approx. 60 to 1 by the lecturer at the b of one candidate each (es per candidate). ssessment: German ar bonus	eginning of the course, approx. 20 minutes) or			
Allocat	tion of p	places				
Additio	nal inf	ormation				
Addition						
Worklo	ad					
150 h						
	ng cycl	6				
	<u> </u>	-				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
	Nr. 3 b)	·				
-		Rechnerarchitektur				
Modul	e appea	rs in				
		a rs in gree (1 major) Compute	er Science (2015)			
Bachelor's degree (1 major) Mathematics (2015)						
Bachelor's degree (1 major) Computational Mathematics (2015)						
Bachelor's degree (1 major) Aerospace Computer Science (2015)						
First state examination for the teaching degree Gymnasium Computer Science (2015) Master's degree (1 major) Physics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Bachelor's degree (1 major) Aerospace Computer Science (2017)						
Bachelor's degree (1 major) Computer Science (2017)						
Bachelor's degree (1 major) Computer Science (2019)						
		ee (1 major) Physics (2				
Master's w	ith 1 majo	Physics (2016)		urg • generated 19-Apr-2025		page 24 / 215
			reg. data re	cord Master (120 ECTS) Physi	k - 2016	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Master's degree (1 major) Physics International (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Bachelor's degree (1 major) Games Engineering (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 25 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Applied Analysis 10-M=AAAN-161-mo1					
Madula southeater					
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					
Contents					
In-depth study of functional analysis and operator theory, Sobolev spaces and partial differential equations, theory of Hilbert spaces and Fourier analysis, spectral theory and quantum mechanics, numerical methods (ir particular FEM methods), principles of functional analysis, function spaces, embedding theorems, compactnee theory of elliptic, parabolic and hyperbolic partial differential equations with methods from functional analysis Recommended previous knowledge:					
Familiarity with the contents of the module "Functional Analysis" is strongly recommended.					
Intended learning outcomes					
The student is acquainted with the fundamental notions, methods and results of higher analysis. He/She is a to establish a connection between his/her acquired skills and other branches of mathematics and questions physics and other natural and engineering sciences.					
Courses (type, number of weekly contact hours, language — if other than German)					
V (4) + Ü (2) Module taught in: German and/or English					
Method of assessment (type, scope, language — if other than German, examination offered — if not every sen					
ster, information on whether module can be chosen to earn a bonus)					
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus					
Allocation of places					
Additional information					
Workload					
300 h					
Teaching cycle					
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in					
Master's degree (1 major) Mathematics (2016)					
Master's degree (1 major) Physics (2016)					
Master's degree (1 major) Economathematics (2016)					
Master's degree (1 major) Mathematical Physics (2016)					
Master's degree (1 major) Computational Mathematics (2016)					
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master's with 1 major Physics (2016) JMU Würzburg • generated 19-Apr-2025 • exam. page 26 / 2 reg. data record Master (120 ECTS) Physik - 2016					

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025) Master's degree (1 major) Economathematics (2025)

Module title				Abbreviation		
Differe	ntial G	eometry			10-M=ADGM-161-m	01
Modul	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathemati		atica				
ECTS 10	1	rical grade	Only after succ. con	ipt. of module(s)		
		-				
Duration 1 seme		Module level graduate	Other prerequisites			
Conter		graduate				
	-	lvanced results in differe	ential geometry, in pa	rticular about differe	ntiable and Riemanı	nian mani-
Basic k	knowled	d previous knowledge: Ige from the modules "In	troduction to Differer	ntial Geometry", "Intr	oduction to Topolog	y" and "Geo-
	· · · ·	s" is recommended.				
Intend	ed lear	ning outcomes				
		acquainted with concep hese methods and know				
Course	es (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (4) + Modul		t in: German and/or Engl	lish			
		essment (type, scope, la		an German, examina	tion offered — if not	everv seme-
		on on whether module c				every serife
a) writt	ten exai	nination (approx. 90 to 1	120 minutes, usually	chosen) or		
		ation of one candidate e		-		
		ation in groups (groups		andidate)		
		ssessment: German or E ffered: In the semester ir		offered and in the cu	beaquant competer	
	ble for		I willen the course is	onered and in the st	insequent semester	
	tion of p		-			
م ما ما : د : د		ormation				
Additio		ormation				
 Worklo						
300 h	Jau					
-	ng cycl	•				
Teacin	ing cycl	e				
Deferre	d to in	IDOL (avamination rag	lations for toaching	dagraa programmac)		
Referred to in LPO I (examination regulations for teaching-degree programmes)						
 Moduli	e appea	ors in				
		ee (1 major) Mathematics	5 (2016)			
	-	ee (1 major) Physics (201				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		ee (1 major) Computatior				
Master's w	ith 1 majo	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 28 / 215

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 29 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title			Abbreviation	
Complex	x Analysis			10-M=AFTH-161-mo	1
Modulo	coordinator		Module offered by	<u> </u>	
Dean of Studies Mathematik (Mathematics)					
		Mathematics) Institute of Mathematics Only after succ. compl. of module(s)			
	Method of grading numerical grade		npl. of module(s)		
	-				
Duration		Other prerequisites	•		
	1 •				
Content					
geometr ons (e. g Recomm	n study of mapping properties ric methods. Structural prope g. elliptic functions). nended previous knowledge:	rties of families of hold	omorphic and merom	iorphic functions. Sp	pecial functi-
	nowledge of the contents of the	ie module introductio	on to Complex Analys	as is recommended	
	d learning outcomes	u demont de st	atha da da da	f history and h	
ticular th	dent is acquainted with the function the (geometric) mapping prop this/her acquired skills and	erties of holomorphic	functions. He/She is	able to establish a c	connection
Courses	(type, number of weekly con	tact hours, language –	– if other than Germa	ın)	
V (4) + Ü Module) (2) taught in: German and/or En	glish			
	of assessment (type, scope,		an German, examina	tion offered — if not	everv seme-
	ormation on whether module				, ,
 a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus 					
Allocatio	on of places				
Addition	nal information				
Workloa	d				
300 h					
Teaching	g cycle				
			•		
Referred	to in LPO I (examination reg	gulations for teaching-	degree programmes)		
Module	appears in				
	s degree (1 major) Mathemati				
	s degree (1 major) Physics (20				
	s degree (1 major) Mathemati	-			
	s degree (1 major) Computation			ark Davaria (END) (
	s teaching degree Gymnasiun				U16)
	nentary course MINT Teacher 5 degree (1 major) Computatio			d) (2010)	
	h 1 major Physics (2016)		•9) urg • generated 19-Apr-2025 •	• exam.	page 30 / 215
2			cord Master (120 ECTS) Physi		

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 31 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Lie Theory 10-M=ALTH-161-m01					1	
Modul	<u>a coord</u>	inator		Module offered by	<u> </u>	
Module coordinator Dean of Studies Mathematik (Mathematics)						
	1	· ·				
ECTS	1	od of grading	Only after succ. compl. of module(s)			
10		rical grade				
Duratio		Module level	Other prerequisites	j		
1 seme		graduate				
Conten	-					
	-	ups and their Lie algebu blications, e.g. in phys		on, structure and cla	ssification of Lie alge	ebras, classic
Basic k	knowled	d previous knowledge: lge of the contents of t nermore, basic knowled				
useful.						
		ning outcomes				
	hese to	acquainted with the fu common problems, ar				
Course	s (type	, number of weekly con	tact hours, language –	– if other than Germa	n)	
V (4) + Module		t in: German and/or En	glish			
Metho	d of ass	sessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
ster, in	formati	on on whether module	can be chosen to earn	a bonus)		
b) oral c) oral Langua Assess	examir examin age of a	nination (approx. 90 to ation of one candidate ation in groups (group: ssessment: German or ffered: In the semester bonus	each (approx. 20 min 5 of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h			,			
-	ng cycl	٩				
		•				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Physics (2016)						
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		Physics (2016)	JMU Würzb	urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil	• exam.	page 32 / 215

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 33 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Τοροίο	Topology 10-M=ATOP-161-m01)1
Modul	e coord	inator		Module offered by		
Dean o	Dean of Studies Mathematik (Mathematics)		Institute of Mathem	atics		
ECTS	Metho	od of grading	Only after succ. compl. of module(s)			
10	numei	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	nts					
		opology, topological ir ng spaces.	variants (e. g. fundam	ental group, connect	ion), construction of	topological
Intend	ed learr	ning outcomes				
		acquainted with the function problems.	Indamental results, the	eorems and methods	in topology and is a	ıble to apply
Course	s (type,	number of weekly con	tact hours, language –	- if other than Germa	n)	
V (4) +	Ü (2)	t in: German and/or En				
			language — if other th can be chosen to earn		tion offered — if not	every seme-
b) oral c) oral Langua Assess	examin examin age of a	ation of one candidate ation in groups (group ssessment: German or ffered: In the semester	9 120 minutes, usually each (approx. 20 minu s of 2, 15 minutes per c English in which the course is	utes) or andidate)	ıbsequent semester	
Allocat	tion of p	olaces				
Additio	onal info	ormation				
Worklo	bad					
300 h						
Teachi	ng cycl	9				
Referre	ed to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
 Modula	e appea	rs in				
		ee (1 major) Mathemati	(2016)			
	-					
Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Mathematical Mysics (2010) Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						
Master's degree (1 major) Physics (2020)						
			n MINT Teacher Educat Education PLUS, Elite			020)
Master's w	rith 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 34 / 215

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Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 35 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title					Abbreviation	
Numbe	Number Theory 10-M=AZTH-161-m01					
Modul	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathematics)		antice)	Institute of Mathematics			
ECTS	1	od of grading	Only after succ. compl. of module(s)			
10		rical grade				
Duratio	<u> </u>	Module level	Other prerequisites			
1 seme		graduate				
Conter	its	0				
applica overvie Recom Basic k	ations to ew of th mendeo knowlec	etic functions and their o prime number distribu e development of mode d previous knowledge: lge of algebra and num , "Introduction to Numl	ution and diophantine ern number theory. ber theory is assumed	equations; discussion, such as can be acq	on of the Riemann h	ypothesis,
		ning outcomes				
The stu structu	udent is ires in n	acquainted with the fu umber theory and know evelopments in numbe	vs methods for the sol			
Course	s (type	, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (4) + Module		t in: German and/or Eng	glish			
ster, in	formati	e ssment (type, scope, on on whether module	can be chosen to earn	a bonus)	tion offered — if not	every seme-
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 mini of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	9				
	<u> </u>					
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Modul	e appea	irs in				
Master's degree (1 major) Mathematics (2016)						
	Master's degree (1 major) Physics (2016)					
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		y course MINT Teacher				
Master's w	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 36 / 215

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 37 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Discret	e title				Abbreviation	
2.00.00	te Mathematics				10-M=VDIM-161-mc	01
Module	e coordinator			Module offered by	l	
	of Studies Mathematik (M	athema	tics)	Institute of Mathen	natics	
ECTS	Method of grading		Only after succ. cor			
5	numerical grade					
Duratio			Other prerequisites	•		
1 seme	· · · · · · · · · · · · · · · · · · ·					
Conten	1-					
graph t Recom	ced methods and results theory or combinatorics) mended previous knowle knowledge of the contents	edge:		_		tography,
	ed learning outcomes				•	
The stu	udent is acquainted with a	advance	ed results in a select	ed topic in discrete	mathematics.	
	es (type, number of weekly			·		
V (3) +		<u> </u>			an <i>)</i>	
Metho	d of assessment (type, sc formation on whether mo	cope, la	nguage — if other th		ition offered — if not	every seme-
Langua	age of assessment: Germa	an or En	glish	utes) or tes per candidate)	ub construction and the	
Langua Assess credita		an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat Additio	age of assessment: Germa sment offered: In the sem ble for bonus	an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information	an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat Additio Worklo	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information	an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat Additio Worklo 150 h	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information	an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat Additio Worklo 150 h Teachin	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information	an or En	glish	tes per candidate)	ubsequent semester	
Langua Assess credita Allocat Additio 150 h Teachin 	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information	an or En	glish which the course is	tes per candidate) offered and in the s		
Langua Assess credita Allocat Additio Worklo 150 h Teachin 	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information oad	an or En	glish which the course is	tes per candidate) offered and in the s		
Langua Assess credita Allocat Additio 150 h Teachin Referre	age of assessment: Germa sment offered: In the sem able for bonus tion of places onal information oad	an or En	glish which the course is	tes per candidate) offered and in the s		
Langua Assess credita Allocat Additio 150 h Teachin Referre Module	age of assessment: Germa sment offered: In the seme able for bonus tion of places onal information oad ng cycle ed to in LPO I (examinatio	an or En ester in	glish which the course is ations for teaching-	tes per candidate) offered and in the s		
Langua Assess credita Allocat Additio Worklo 150 h Teachin Referre Module	age of assessment: Germa sment offered: In the sema able for bonus tion of places onal information oad ag cycle ed to in LPO I (examination e appears in	an or En ester in on regul	glish which the course is ations for teaching- (2016)	tes per candidate) offered and in the s		
Langua Assess credita Allocat Additio 150 h Teachin Referre Module Master Master Master	age of assessment: Germa sment offered: In the sema able for bonus tion of places onal information oad ad ag cycle ed to in LPO I (examination e appears in r's degree (1 major) Mather r's degree (1 major) Physic r's degree (1 major) Nanos	an or En ester in on regul ematics cs (2016 structur	glish which the course is ations for teaching- (2016) ;) e Technology (2016)	tes per candidate) offered and in the su degree programmes)		
Langua Assess credita Allocat Additio Worklo 150 h Teachin Referre Module Master Master Master Master	age of assessment: Germa sment offered: In the sema ble for bonus tion of places onal information oad ad age cycle ed to in LPO I (examination e appears in r's degree (1 major) Mather r's degree (1 major) Nanos r's degree (1 major) Nanos	ematics cs (2016 structure omather	glish which the course is ations for teaching- (2016) atics (2016)	tes per candidate) offered and in the su degree programmes)		
Langua Assess credita Allocat Additio Worklo 150 h Teachin Referre Module Master Master Master Master Master	age of assessment: Germa sment offered: In the sema ble for bonus tion of places onal information oad age cycle ed to in LPO I (examination e appears in f's degree (1 major) Mather f's degree (1 major) Nanos f's degree (1 major) Econo f's degree (1 major) Econo	an or En ester in on regul ematics cs (2016 structur omather ematica	glish which the course is ations for teaching- (2016) b) e Technology (2016) natics (2016) l Physics (2016)	tes per candidate) offered and in the si degree programmes)		
Langua Assess credita Allocat Additio 150 h Teachin Referre Master Master Master Master Master Master Master	age of assessment: Germa sment offered: In the sema able for bonus tion of places onal information oad ad ad ad ad ad ad ad ad ad ad ad ad a	ematics cs (2016 structure omather ematica asium N	glish which the course is ations for teaching- (2016) at Technology (2016) natics (2016) I Physics (2016) MINT Teacher Educat	tes per candidate) offered and in the su degree programmes)	ork Bavaria (ENB) (2	
Langua Assess credita Allocat Additio 150 h Teachin Referre Module Master Master Master Master Master Supple	age of assessment: Germa sment offered: In the sema able for bonus tion of places onal information oad ad ag cycle ed to in LPO I (examination e appears in r's degree (1 major) Mather r's degree (1 major) Mather r's degree (1 major) Nanos r's degree (1 major) Nanos r's degree (1 major) Mather r's teaching degree Gymma ementary course MINT Tea	ematics cs (2016 structur omather ematica asium M acher Ec	glish which the course is ations for teaching- (2016) b) e Technology (2016) natics (2016) I Physics (2016) AINT Teacher Educat lucation PLUS, Elite	tes per candidate) offered and in the su degree programmes)	ork Bavaria (ENB) (2	
Langua Assess credita Allocat Additio Yorklo 150 h Teachin Referre Master Master Master Master Master Master Master Supple Master	age of assessment: Germa sment offered: In the sema able for bonus tion of places onal information oad ad ad ad ad ad ad ad ad ad ad ad ad a	ematics cs (2016 structur omather ematica asium M acher Ec ematics	glish which the course is ations for teaching- (2016) b) e Technology (2016) natics (2016) I Physics (2016) I Physics (2016) MINT Teacher Educat lucation PLUS, Elite (2019)	tes per candidate) offered and in the su degree programmes) ion PLUS, Elite Netw Network Bavaria (EN	ork Bavaria (ENB) (2	

Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025) Master's degree (1 major) Economathematics (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 39 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Modul	Module title Abbreviation					
Group	s and th	eir Representations			10-M=VGDS-161-mc	01
Modul	e coord	inator		Module offered by		
		es Mathematik (Mathem	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. con			
10		rical grade				
			Other prerequisites			
1 seme		graduate				
Conter		3	1			
	oermuta ings of	ation groups and charact Schur.	er theory of finite gro	ups, interrelations ar	nd special technique	s such as
Basic l		d previous knowledge: Ige of algebra is assume pra".	d, such as can be acc	quired in the module	s "Introduction to Al	gebra" and
Intend	ed learı	ning outcomes				
	search o	asters advanced algebra questions in group theor				
Course	es (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (4) + Modul		t in: German and/or Engl	lish			
Metho	d of ass	sessment (type, scope, la	anguage — if other th	an German, examina	tion offered — if not	every seme-
		on on whether module c				
a) writt	ten exai	mination (approx. 90 to 1	120 minutes, usually	chosen) or		
		ation of one candidate e		-		
		ation in groups (groups		andidate)		
Assess		ssessment: German or E ffered: In the semester in bonus		offered and in the su	ıbsequent semester	
	tion of p		-			
Alloca		Jaces				
		-	-			
Additio	onal info	ormation				
Worklo	oad		-			
300 h			_			
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regu	llations for teaching-	degree programmes)		
Modul	e appea	ars in				
Master	r's degre	ee (1 major) Mathematics	5 (2016)			
Master	r's degre	ee (1 major) Physics (201	.6)			
	-	ee (1 major) Mathematica				
	-	ee (1 major) Computatior				
		ning degree Gymnasium				016)
		y course MINT Teacher E			B) (2016)	
		ee (1 major) Computation		-		
Master's w	11th 1 majoi	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 40 / 215

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 41 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title			Abbreviation	
Geome	trical Mechanics			10-M=VGEM-161-m01	
Module	e coordinator		Module offered by	L	
	f Studies Mathematik (Math	ematics)	Institute of Mathematics		
ECTS	Method of grading	Only after succ. co		latics	
10	numerical grade				
Duratio	, <u> </u>	Other prerequisites	5		
1 seme			3		
Conten					
tic geor phase s Recomm Advanc Geome ge of th	odule builds on the topics co metry, cotangent bundles ar space reduction, normal for mended previous knowledge ced knowledge of differentia try". Knowledge of the conte neoretical mechanics can als ed learning outcomes	d other examples of syn ns, introduction to Poiss e: I geometry is required, s nts of the module "Intro	nplectic manifolds, s son geometry. such as can be acquir	ymmetries and Noethe ed in the module "Diff	er theorem, erential
		atod advanced and	tions of differential -	omotru to socie stuite	nachaniar
	Ident is acquainted with sele e is able to establish a conne				
	estions in physics.				cinatics
Course	s (type, number of weekly co	ontact hours, language -	– if other than Germa	n)	
V (4) +	Ü (2)				
Module	e taught in: German and/or E	Inglish			
	d of assessment (type, scop formation on whether modu			tion offered — if not ev	very seme-
a) writt	en examination (approx. 90	to 120 minutes, usually	chosen) or		
	examination of one candida				
	examination in groups (grou uge of assessment: German (candidate)		
	ment offered: In the semest		s offered and in the su	ubsequent semester	
	ble for bonus			I	
Allocat	ion of places				
Additio	onal information				
Worklo	ad				
300 h					
-	ng cycle				
	ing cycle				
Poforro	ed to in LPO I (examination r	agulations for toaching	degree programmac		
Module	e appears in				
Master	's degree (1 major) Mathema	itics (2016)			
	's degree (1 major) Physics (
	's degree (1 major) Mathema	•			
	's teaching degree Gymnasi mentary course MINT Teach				6)
	ith 1 major Physics (2016)		ourg • generated 19-Apr-2025		page 42 / 215
			ecord Master (120 ECTS) Physi		

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Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Mathematics (2023)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 43 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

	e title			Abbreviation	
Selecte	ed Topics in Mathematical P	nysics		10-M=VMPH-161-m	01
Modul	e coordinator		Module offered by		
	of Studies Mathematik (Math	amatics)	Institute of Mathematics		
ECTS	Method of grading	Only after succ. con			
10	numerical grade				
Duratio		Other prerequisites			
1 semester graduate					
Conten					
		· c · · ·		• • • • •	
	ed topics in mathematical ph sciences, geometric field theo			ild dynamics, mathe	matical ma-
Recom	mended previous knowledge	:			
	ding on the content, basic ar		from different areas	of analysis is require	ed. In case of
doubt,	it is recommended to consu	t the lecturer.			
Intend	ed learning outcomes				
	udent is acquainted with an a ction between his/her acquir				
Course	es (type, number of weekly co	ntact hours, language –	- if other than Germa	n)	
V (4) +	Ü (2)				
	e taught in: German and/or E	nglish			
Metho	d of assessment (type, scope	e, language — if other th	an German, examina	tion offered — if not	every seme-
	formation on whether modu				,
a) writt	ten examination (approx. 90	to 120 minutes, usually	chosen) or		
	examination of one candida		-		
	examination in groups (grou		andidate)		
-	age of assessment: German of sevents of the sevent of the sevento sevent of the sevent of the sevent of the sevent	-	offered and in the su	ibsoquent comester	
	able for bonus		onered and in the st	ibsequent semester	
	tion of places				
Allocal					
• • • • • • • •	linformation				
Additio	onal information				
 Worklo					
 Worklo 300 h					
 Worklo 300 h	pad				
 Worklo 300 h Teachi	pad	egulations for teaching-	degree programmes)		
 Worklo 300 h Teachi	oad ing cycle	egulations for teaching-o	degree programmes)		
 Worklo 300 h Teachi Referre	oad ing cycle ed to in LPO I (examination r	egulations for teaching-	degree programmes)		
 Worklo 300 h Teachi Referre Modulo	oad ing cycle ed to in LPO I (examination r e appears in		degree programmes)		
 Workld 300 h Teachi Referre Module	oad ing cycle ed to in LPO I (examination r e appears in r's degree (1 major) Mathema	tics (2016)	degree programmes)		
 Workla 300 h Teachi Referre Module Master Master	oad ing cycle ed to in LPO I (examination r e appears in	tics (2016) 2016)	degree programmes)		
 Workld 300 h Teachi Referre Module Master Master Master	oad ing cycle ed to in LPO I (examination r e appears in r's degree (1 major) Mathema r's degree (1 major) Physics (tics (2016) 2016) tical Physics (2016)			
 Worklo 300 h Teachi Referre Modulo Master Master Master Master	ed to in LPO I (examination r e appears in r's degree (1 major) Mathema r's degree (1 major) Mathema	tics (2016) 2016) tical Physics (2016) tional Mathematics (201	6)	ork Bavaria (ENB) (20	016)
 Workld 300 h Teachi Referre Module Master Master Master Master Master Master	pad ing cycle ed to in LPO I (examination r e appears in r's degree (1 major) Mathema r's degree (1 major) Physics (r's degree (1 major) Mathema r's degree (1 major) Computa	tics (2016) 2016) tical Physics (2016) tional Mathematics (201 Im MINT Teacher Educat	6) ion PLUS, Elite Netwo		016)
 Workld 300 h Teachi Referre Module Master Master Master Master Supple Master	ad ang cycle ed to in LPO I (examination r e appears in r's degree (1 major) Mathema r's degree (1 major) Mathema r's degree (1 major) Mathema r's degree (1 major) Computa r's teaching degree Gymnasin ementary course MINT Teacher r's degree (1 major) Computa	tics (2016) 2016) tical Physics (2016) tional Mathematics (201 Im MINT Teacher Educat er Education PLUS, Elite tional Mathematics (201	6) ion PLUS, Elite Netwo Network Bavaria (EN		016)
 Worklo 300 h Teachi Referre Master Master Master Master Supple Master Master Master	ed to in LPO I (examination r e appears in r's degree (1 major) Mathema r's degree (1 major) Physics (r's degree (1 major) Mathema r's degree (1 major) Computa r's teaching degree Gymnasin ementary course MINT Teach	tics (2016) 2016) tical Physics (2016) tional Mathematics (201 IM MINT Teacher Educat er Education PLUS, Elite tional Mathematics (201 tics (2019)	6) ion PLUS, Elite Netwo Network Bavaria (EN	B) (2016)	016)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 45 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title			Abbreviation	
Numeri	c of Partial Differential Equation	ons		10-M=VNPE-161-mc	01
Module	coordinator		Module offered by		
	f Studies Mathematik (Mathem	natice)	Institute of Mathematics		
ECTS	Method of grading	Only after succ. con		Idlics	
10	numerical grade				
Duratio		Other prerequisites			
1 seme					
Conten	1				
(numer discont Recom We reco	of partial differential equations ical methods for elliptic, parab tinuous Gelerkin finite element mended previous knowledge: ommend basic knowledge of fu he modules "Introduction to Fu	oolic and hyperbolic pa is method, finite differ Inctional analysis and	artial differential equ ences and finite volu partial differential e	ations; finite elemen ume methods). equations, such as ca	nts method,
Intende	ed learning outcomes				
The stu	dent is acquainted with advan	ced methods for discr	etising partial differe	ential equations.	
Course	s (type, number of weekly cont	act hours, language –	- if other than Germa	in)	
V (4) +					
11	e taught in: German and/or Eng	lish			
	d of assessment (type, scope, formation on whether module			tion offered — if not	every seme-
a) writt	en examination (approx. 90 to	120 minutes, usually	chosen) or		
	examination of one candidate		-		
	examination in groups (groups		andidate)		
-	ge of assessment: German or ment offered: In the semester	-	offered and in the su	ibsoquent comester	
	ble for bonus	in which the course is	oncrea and in the st	ibsequent semester	
Allocat	ion of places				
		_			
•					
Additio	nal information				
		_			
Worklo	ad				
300 h					
Teachi	ng cycle				
Referre	d to in LPO I (examination reg	ulations for teaching-o	degree programmes)		
Module	e appears in				
	's degree (1 major) Mathematic				
	's degree (1 major) Physics (20				
	's degree (1 major) Economath				
	's degree (1 major) Mathematic	•			
	's degree (1 major) Computatio			ork Dovoria (END) (-	o.()
	's teaching degree Gymnasium				016)
	mentary course MINT Teacher 's degree (1 major) Computatio			d) (2010)	
	ith 1 major Physics (2016)		9) Irg • generated 19-Apr-2025 •	• exam.	page 46 / 215
			cord Master (120 ECTS) Physi		

Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025) Master's degree (1 major) Economathematics (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 47 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Modul	e title			Abbreviation	
Partial	Differential Equations of N	athematical Physics		10-M=VPDP-161-m	01
Module	e coordinator		Module offered by	<u> </u>	
	f Studies Mathematik (Mat	hematics)	Institute of Mathem	natics	
ECTS	Method of grading	Only after succ. co			
10	numerical grade				
Duratio		Other prerequisite	26		
1 seme					
Conten					
examp ons an Recom Basic k	, parabolic, and hyperbolic les; initial and boundary va d generalisations; Hilbert s mended previous knowledg nowledge from the module	lue problems; well-pose pace methods; Sobolev ge: s "Ordinary Differential	ed and ill-posed proble spaces and Fourier tra Equations" and "Intro	ems; solution metho ansforms. duction to Partial Dif	ods; extensi-
Intend	ed learning outcomes				
equation	ident is acquainted with fui ons, as well as standard ex en his/her acquired skills a	amples from mathemation	cal physics. He/She is	able to establish a	
Course	s (type, number of weekly of	contact hours, language	— if other than Germa	n)	
V (4) + Module	Ü (2) e taught in: German and/or	English			
	d of assessment (type, scor		han German, examina	tion offered — if not	every seme-
	formation on whether mod				
c) oral Langua Assess	examination of one candid examination in groups (gro age of assessment: German ment offered: In the semes ble for bonus	ups of 2, 15 minutes per or English	candidate)	ubsequent semester	
Allocat	ion of places				
Additio	onal information				
Worklo	ad				
300 h					
-	ng cycle				
Referre	ed to in LPO I (examination	regulations for teaching	-degree programmes		
			, <u> </u>		
Modul	e appears in				
	's degree (1 major) Mathem	vatics (2016)			
	's degree (1 major) Mathem				
	's degree (1 major) Mathem				
	's degree (1 major) Comput	•	016)		
	's teaching degree Gymnas			ork Bavaria (ENB) (2	016)
	ementary course MINT Teach				
	ith 1 major Physics (2016)	JMU Würz	burg • generated 19-Apr-2025	• exam.	page 48 / 215
		reg. data	record Master (120 ECTS) Physi	k - 2016	

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 49 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Pseudo	o Riema	nnian and Riemannia	n Geometry		10-M=VPRG-161-m01	
Module	e coordi	nator		Module offered by		
Dean o	of Studie	es Mathematik (Mathe	matics)	Institute of Mathem	natics	
ECTS		d of grading	Only after succ. co	Only after succ. compl. of module(s)		
10	numer	ical grade				
Duratio	· · · · · · · · · · · · · · · · · · ·	Module level	Other prerequisites	5		
1 seme	ester	graduate				
Conten	nts					
nian ar map, Ja	nd pseu acobi fie e operat	do-Riemannian manif elds, comparison theo	olds, Levi-Civita conne rems in Riemannian ge	ction and curvature, § cometry, submanifold	these in more detail: Rieman- geodesics and the exponential Is, integration, d'Alembert and I applications in general relativit	
Advano Geome	ced kno etry". Kn		geometry is required, s		red in the module "Differential /", "Geometric Mechanics" and	
Intend	ed learn	ing outcomes				
manifo	lds.He		sh a connection betwe		nannian and pseudo-Riemannia skills and other branches of ma-	
Course	es (type,	number of weekly co	ntact hours, language -	– if other than Germa	in)	
V (4) +		,			,	
с I <i>р</i>	• •	in: German and/or E	nglish			
			, language — if other th e can be chosen to earr		tion offered — if not every seme	
b) oral c) oral Langua Assess	examin examina age of as	ation of one candidat ation in groups (group ssessment: German o ffered: In the semeste	o 120 minutes, usually e each (approx. 20 min os of 2, 15 minutes per o r English r in which the course is	utes) or candidate)	ubsequent semester	
Allocat	tion of p	laces				
Additio	onal info	ormation				
Worklo	ad					
300 h						
-	ng cycle	9				
	0 -) - 0					
Referre	ed to in	LPOI (examination re	egulations for teaching-	degree programmes)		
	e appea					
	-	ee (1 major) Mathemat				
	-	ee (1 major) Physics (2				
		ee (1 major) Mathemat	-			
A +	ith 1 major	Physics (2016)	IMII Würzh	ourg • generated 19-Apr-2025 •	• exam. page 50 / 215	

Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 51 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation
Operat	Operations Research for students of other subjects				10-M-ORSaf-152-m01
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathematics)		Institute of Mathem	natics		
ECTS					
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Linear	prograr	nming, duality theory, tra	nsport problems, inte	egral linear program	ming, graph theoretic problems.
Intend	ed leari	ning outcomes			
for solv probler	ving ma ns, bot		pecially in economics rically.	s. He/She is able to	h, as required as a central tool apply these methods to practical
V (4) +		, number of weekly colla	et nours, taliguage –		
Metho	d of ass	s essment (type, scope, la on on whether module ca			tion offered — if not every seme-
Assess credita Allocat	ble for		which the course is	offered and in the su	ubsequent semester
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Module	e appea	irs in			
		gree (1 major) Computer S	Science (2015)		
	-	ee (1 major) Physics (201			
		gree (1 major) Computer S			
		gree (1 major) Computer S	-		
	-	ee (1 major) Physics (202 ee (1 major) Physics Inter			
	-	gree (1 major) Physics inter		bility (2021)	
Sachet	51 5 GC				

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 52 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation
Advand	ed Ana	llysis			10-M-VAN-152-m01
Module	e coord	inator		Module offered by	
Dean of Studies Mathematik (Mathematics)		atics)	Institute of Mathem	atics	
ECTS Method of grading		Only after succ. com	pl. of module(s)		
7	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Continu	uation	of analysis in several vari	ables, integration the	eorems.	
Intende	ed lear	ning outcomes			
		acquainted with advanc understand the construct			of the Lesbegue integral, he or
			•	•	
		, number of weekly conta	ict nours, language –	· If other than Germa	n <i>)</i>
V (4) +					
		s essment (type, scope, la ion on whether module ca			tion offered — if not every seme-
		mination (approx. 90 to 1			
		nation of one candidate e nation in groups (groups o			
		ssessment: German and		per candidate)	
credita			0.1		
Allocat	ion of p	olaces			
Additio	onal inf	ormation			
Worklo	ad				
210 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Module	e appea	ars in			
Bachel	or's de	gree (1 major) Mathemati	cs (2015)		
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2015)		
	Bachelor's degree (1 major) Computational Mathematics (2015)				
		gree (1 major) Mathemati			
	-	ee (1 major) Physics (201	-		
	-	ee (1 major) Nanostructur	•, · ·		
	-	ee (1 major) Nanostructur			
	-	ee (1 major) Physics (202			
	-	ee (1 major) Physics Inter			
		ee (1 major) Quantum Eng			
	-	ee (1 major) Quantum Teo gree (1 major) Mathemati			
Dachel	or s ue	giee (1 major) Mathemati	(2023)		

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 53 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module t	title				Abbreviation		
Cosmolo	gy				11-AKM-161-m01		
Module	coordi	nator		Module offered by			
Managin and Astro		ctor of the Institute of cs	Theoretical Physics	Faculty of Physics and Astronomy			
ECTS I				compl. of module(s)			
6 r	numeri	cal grade					
Duration	1	Module level	Other prerequisites				
1 semest	ter	graduate					
Contents	5						
matter, p	Expanding space-time, Friedmannian cosmology, basics of general relativity, the early universe, inflation, dark matter, primordial nucleosynthesis, cosmic microwave background, structure formation, galaxies and galaxy clusters, intergalactic medium, cosmological parameters.						
Intended	l learn	ing outcomes					
	te the	n to observations. The	of cosmology. They kno y have gained insights				
Courses	(type,	number of weekly con	tact hours, language –	- if other than Germa	n)		
V (3) + R Module t		in: German or English					
			language — if other the can be chosen to earn		tion offered — if not	every seme-	
b) oral ex c) oral ex d) project e) presen If a writte stead tak of assess nation da Languag	xamina kamina tt repo ntatior en exa ke the sment ate at f e of as	ation in groups (groups rt (approx. 8 to 10 pag I/talk (approx. 30 min mination was chosen form of an oral examir is changed, the lectur the latest. sessment: German an	each (approx. 30 minu s of 2, approx. 30 minu es) or utes). as method of assessme ation of one candidate er must inform student	tes per candidate) of ent, this may be char e each or an oral exa is about this by four y	nged and assessmer mination in groups. I weeks prior to the or	If the method	
Allocatio	on of p	laces					
Addition	al info	rmation					
Workloa	d						
180 h							
Teaching	g cycle						
Referred	to in l	POI (examination res	gulations for teaching-	degree programmes)			
			<u> </u>				
Module a	appear	rs in					
		e (1 major) Mathemati	cs (2016)				
	-	e (1 major) Physics (20					
	-	e (1 major) Mathemati					
Master's	degre	e (1 major) Computatio	onal Mathematics (201	6)			
Master's with	1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 54 / 215	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 55 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

mouuld	e title				Abbreviation
High Er	nergy A	strophysics			11-APL-161-m01
Module	e coordi	nator		Module offered by	
		ctor of the Institute of T	heoretical Physics	Faculty of Physics and Astronomy	
	trophys		neoretical inysies		
ECTS	<u> </u>	d of grading	Only after succ. compl. of module(s)		
6		ical grade		-	
Duratio	n	Module level	Other prerequisites	5	
1 seme	ster	graduate			
Conten	ts				
		esses, interaction of lig roduction, astrophysica			sses, pair creation, nuclear pro-
		ling outcomes		•	
The stu	dent ga			rgy Astrophysics, suc	h as particle acceleration and
Course	s (type,	number of weekly cont	act hours, language -	– if other than Germa	an)
V (3) +					
		in: German or English			
		essment (type, scope, l on on whether module o			ation offered — if not every seme
d) proje e) pres If a writ	ect repo entation tten exa	ort (approx. 8 to 10 page n/talk (approx. 30 minu mination was chosen a	es) or tes). s method of assessm		nged and assessment may in-
d) proje e) pres If a writ stead t of asse nation Langua Assess	ect repo entation tten exa ake the ssment date at uge of as	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina is changed, the lecture the latest. ssessment: German and fered: In the semester i	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam
d) proje e) press If a writ stead t of asse nation Langua Assess	ect repo entation tten exa ake the ssment date at age of as ment of	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina is changed, the lecture the latest. ssessment: German and fered: In the semester i	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam
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d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio Worklo	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and fered: In the semester i	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam
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d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio 180 h	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p mal info	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina is changed, the lecture the latest. ssessment: German and fered: In the semester i laces	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam
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d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Worklo 180 h Teachin Referre	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p mal info	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and fered: In the semester i ilaces ormation	es) or tes). s method of assessm ation of one candidat or must inform studen d/or English n which the course is	eent, this may be cha e each or an oral exa ts about this by four offered and in the su	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Worklo 180 h Teachin Referre Module	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p onal info ad ad ad ad ad ad	ort (approx. 8 to 10 page n/talk (approx. 30 minu imination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and fered: In the semester i ilaces ormation	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English n which the course is ulations for teaching-	eent, this may be cha e each or an oral exa ts about this by four offered and in the su	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master	ect repo entation iten exa ake the ssment date at ge of as ment of ion of p onal info ad ad ed to in 's degree 's degree	e present (approx. 8 to 10 page n/talk (approx. 30 minu mination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and fered: In the semester i laces prmation e LPO I (examination reg rs in e (1 major) Mathematic e (1 major) Physics (20)	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English n which the course is ulations for teaching- es (2016) 16)	eent, this may be cha e each or an oral exa ts about this by four offered and in the su	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master Master	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p mal info ad ad ad ad ad ad ad ad ad ad ad ad ad	e tr (approx. 8 to 10 page n/talk (approx. 30 minu mination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and fered: In the semester i laces prmation e LPO I (examination reg rs in e (1 major) Mathematic e (1 major) Mathematic e (1 major) Mathematic	es) or tes). s method of assessm ation of one candidat or must inform studen d/or English n which the course is ulations for teaching- es (2016) 16) al Physics (2016)	eent, this may be cha e each or an oral exa ts about this by four offered and in the su degree programmes)	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Worklo 180 h Teachin Referre Master Master Master Master Master	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p onal info ad ad ad ad ad ad ad ad ad ad ad ad ad	e Try in a set of the semester of the semeste	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English n which the course is ulations for teaching- es (2016) 16) 16) 16) nal Physics (2016) nal Mathematics (2016)	eent, this may be cha e each or an oral exa ts about this by four offered and in the su degree programmes)	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Worklo 180 h Teachin Referre Master Master Master Master Master Master	ect repo entation tten exa ake the ssment date at ge of as ment of ion of p onal info ad ad ed to in s degre 's degre 's degre 's degre 's degre	e (1 major) Mathematic e (1 major) Mathematic e (1 major) Computatio ing degree Gymnasium	es) or tes). s method of assessm ation of one candidat er must inform studen d/or English n which the course is ulations for teaching- es (2016) 16) al Physics (2016) nal Mathematics (2023 MINT Teacher Educat	eent, this may be cha e each or an oral exa ts about this by four offered and in the su degree programmes)	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master Master Master Supple	ect repo entation iten exa ake the ssment date at ge of as ment of ion of p onal info ad ad ad ad ad ad ad ad ad ad ad ad ad	e Try in a set of the semester of the semeste	es) or tes). s method of assessm ation of one candidat or must inform studen d/or English n which the course is ulations for teaching- ss (2016) 16) cal Physics (2016) nal Mathematics (2017) mal Mathematics (2017) MINT Teacher Educat Education PLUS, Elite	eent, this may be cha e each or an oral exa ts about this by four offered and in the su degree programmes)	nged and assessment may in- mination in groups. If the metho weeks prior to the original exam ubsequent semester

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 57 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module					Abbreviation	
Astropl	hysics				11-APM-242-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of T sics	heoretical Physics	Faculty of Physics and Astronomy		
			Only after succ. con	ompl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Telesco Mediun tive Gal	opes ar n, Mole lactic N	onomy, Coordinates an Id Detectors, Stellar Stru ecular Clouds, Structure Iuclei, Large-Scale Struc	ucture and Atmospher of the Milky Way, the	es, Stellar Evolution	and their End Stages	s, Interstellar
Intende	ed lear	ning outcomes				
thods a rious ol	and ins bject cl	as achieved a deepene truments of astrophysic asses in the context of	al research. He/She is theoretical astrophysi	able to interpret ast cal models.	ronomical observati	
		, number of weekly con	act hours, language –	- if other than Germa	n)	
V (2) + Module	• •	t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
c) oral e d) proje e) prese If a writ stead ta of asse nation e Langua	examin ect repo entatio tten exa ake the ssmen date at age of a	nation of one candidate ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: German an ffered: In the semester	of 2, approx. 30 minutes) or ites). Is method of assessmation of one candidate er must inform student	tes per candidate) o ent, this may be char e each or an oral exa ts about this by four	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocat		-				
			_			
Additio	nal inf	ormation				
Approv	al from	examination committe	e required.			
Worklo	ad					
180 h						
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module	20000	ore in				
		ee (1 major) Physics (20	16)			
Master	's degr	ee (1 major) Physics (20 ee (1 major) Mathematic ee (1 major) Physics (20	cal Physics (2016)			
	-	r Physics (2016)	JMU Würzb	urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 58 / 215



Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 59 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation	
		bservational Astronomy	1		11-ASM-161-m01	
A4		•		Mandala affanad bar		
Module coordinator				Module offered by	· · ·	
Managing Director of the Institute of Theoretical Physics and Astrophysics			heoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS		od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
		oservational astronomy tical, X-ray and gamma-	-	gnetic spectrum. Eval	uation of observatio	onal data
		ning outcomes	_ ,			
dio, op	tical, X	e methods used in obs -ray and gamma-ray ene luct astronomical obser	ergies). Knowledge of			
Course	s (type	, number of weekly cont	act hours, language –	– if other than Germa	n)	
V (3) + Module	• •	t in: German or English				
		sessment (type, scope, l on on whether module			tion offered — if not	every seme-
If a writ stead to of assention Langua	ten exa ake the ssmen date at ge of a	n/talk (approx. 30 minu amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: German and ffered: In the semester i	is method of assessm ation of one candidat er must inform studen d/or English	e each or an oral exa ts about this by four	mination in groups. weeks prior to the or	If the methoo riginal exami
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h			_			
Teachi		0				
	ig tyti	e	_			
Referre	d to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module	e appea	ars in				
		ee (1 major) Mathematic	cs (2016)			
	-	ee (1 major) Physics (20				
Master	's degr	ee (1 major) Nanostructi	ure Technology (2016)			
	-	ee (1 major) Computatio ning degree Gymnasium			ork Bavaria (ENB) (20	016)
Master's wi	ith 1 majoi	r Physics (2016)		urg • generated 19-Apr-2025 •		page 60 / 215
			reg. data re	cord Master (120 ECTS) Physil	K - 2016	

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Quantum Technology (2021)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 61 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module					Abbreviation
Introdu	ction t	o Space Physics			11-ASP-161-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Theoretical Physics and Astrophysics			eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
3. Elem 4. The s 5. Accel	mics o ents of sun and leration	f charged particles in ma space physics d heliosphere n and transport of energe s to measure energetic pa	tic particles in the he	eliosphere	
		ning outcomes			
The stu mics of	dents a charge	acquire basic knowledge	the heliosphere. The		the characterisation of the dyna- ameters and theoretical concepts
Courses	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)
V (3) + F Module		t in: German or English			
Method	l of ass	essment (type, scope, la	nguage — if other th	an German, examina	tion offered — if not every seme-
ster, inf	formati	on on whether module ca	an be chosen to earn	a bonus)	
b) oral e c) oral e d) proje e) prese lf a writ stead ta of asses nation o Langua	examin examin ect repo entatio ten exa ake the ssmen date at ge of a ment o	form of an oral examina t is changed, the lecturer the latest. ssessment: German and, ffered: In the semester in	ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessmu tion of one candidate must inform student for English	tes per candidate) o ent, this may be char e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
180 h					
Teachin	ng cycl	e			
Referre	d to in	LPO I (examination regu	lations for teaching-	degree programmes)	
Module	appea	irs in			
Master'	s degre	ee (1 major) Mathematics	(2016)		

Master's with 1 major Physics (2016)

Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module	e title				Abbreviation	
Theore	tical As	strophysics			11-AST-161-m01	
Module	coord	inator		Module offered by	<u> </u>	
Managing Director of the Institute of Theoretical Physics Faculty of Physics and As			nd Astronomy			
•	and Astrophysics			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,	
ECTS		od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conten	ts					
		retical astrophysics such jets, shock waves, radiat			olack holes, superno	ovae, pulsars,
Intende	ed lear	ning outcomes				
Knowle	dge of	basic processes and met	thods of Theoretical /	Astrophysics. Ability	to formulate theoret	tical models.
		, number of weekly conta				
V (2) +			,		,	
• •	• •	t in: German or English				
Method	d of ass	sessment (type, scope, la			tion offered — if not	t every seme-
ster, in	formati	ion on whether module ca	an be chosen to earn	a bonus)		
		mination (approx. 90 to 1				ſ
		nation of one candidate e		-		
		ation in groups (groups o		ites per candidate) o	r	
		ort (approx. 8 to 10 pages n/talk (approx. 30 minut				
		amination was chosen as		ent, this may be cha	nged and assessme	nt may in-
		e form of an oral examina				
		t is changed, the lecturer	must inform student	ts about this by four	weeks prior to the o	riginal exami-
		the latest.				
		ssessment: German and, ffered: In the semester ir		offered and in the cu	ubcoquent comester	
Allocat				onered and in the st	ibsequent semester	
AllULAL		JIACES				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)		
Module	e appea	ars in				
Master	's degr	ee (1 major) Mathematics	5 (2016)			
Master	's degr	ee (1 major) Physics (201	6)			
	-	ee (1 major) Mathematica	•			
	-	ee (1 major) Computation				
		hing degree Gymnasium				016)
		ry course MINT Teacher E			B) (2016)	
	-	ee (1 major) Computation		•		
waster's wi	un 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 64 / 215

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 65 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module					Abbreviation	
		Physics			11-ATP-242-m01	
Module	e coord	inator		Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics			neoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS Method of grading Only after succ. compl. of module(s)						
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
mics. R and Ru	adiativ naway.	tmospheres. Planetary a e transfer and radiative Physics of clouds. Elect mic rays. Atmospheres o	balance. Fluid mecha ric and magnetic field	nics. Greenhouse eff	ect. Climate Models	: Equilibrium
Intende	ed lear	ning outcomes				
ar-Earth ration c	n space of exop	e knowledge of the physi e. They are able to use th lanets. They are able to u al warming.	e acquired knowledg	e in the planning of s	space missions and	in the explo-
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (2) + Module		t in: German or English				
Method	d of ass	sessment (type, scope, la on on whether module c			tion offered — if not	every seme-
b) oral c) oral d d) proje e) prese lf a writ stead ta of asse nation Langua Assess	examir examin ect repo entatio tten exa ake the ssmen date at ge of a ment o	mination (approx. 90 to a nation of one candidate of ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minut amination was chosen as form of an oral examinat t is changed, the lecture the latest. ssessment: German and ffered: In the semester in	each (approx. 30 minu of 2, approx. 30 minu s) or tes). s method of assessme ation of one candidate r must inform student /or English	tes per candidate) of ent, this may be char e each or an oral exacts s about this by four y	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocat	ion of p	olaces				
 Additio	onal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	۵				
reaction	is cyce					
Referre	d to in	LPO I (examination regu	ulations for teaching-o	degree programmes)		
Module						
	-	ee (1 major) Physics (201 ee (1 major) Mathematic				
Master's wi	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 66 / 215

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Master's degree (1 major) Physics (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 67 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation	
Selecte	d Topi	cs of Theoretical Eleme	ntary Particle Physics		11-ATTP-161-m01	
Module coordinator			Module offered by			
Managing Director of the Institute of Theoretical Physics Faculty of Ph and Astrophysics			Faculty of Physics a	and Astronomy		
ECTS	Metho	d of grading	Only after succ. cor	npl. of module(s)		
6	numei	ical grade				
Duratio	n	Module level	Other prerequisites	5		
1 semes	ster	graduate				
Conten	ts					
1. Adva	nced te Iomenc s physi		calculations of scatte			
Intende	ed learr	ing outcomes				
neutrin test the	o physi ese exte	are familiar with the test cs. They are able to for ensions in low energy e number of weekly con	mulate extensions of t xperiments, at high en	he standard model. ergy colliders and in	Furthermore, they ki cosmology.	
V (3) + I						
		t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	t every seme-
b) oral of c) oral of d) project e) presect If a writt stead ta of assect nation of Langua Assession	examin examin ect repo entatio ten exa ake the ssmen date at ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 min mination was chosen form of an oral examin : is changed, the lectur the latest. ssessment: German an ffered: In the semester	each (approx. 30 minu of 2, approx. 30 minu es) or utes). as method of assessm ation of one candidate er must inform studen d/or English	tes per candidate) o ent, this may be char e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
Allocat	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachir	ng cycle	9				
Referre	d to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
			0	- , 0		
Module	annea	rs in				
Module Master			cs (2016)			
Master'	's degre	rs in ee (1 major) Mathemati ee (1 major) Physics (20				

Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 69 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation		
Biophy	ysical Me	asurement Technolog	y in Medical Science		11-BMT-161-m01		
Modul	e coordir	ator		Module offered by	<u> </u>		
Manag	ging Direc	tor of the Institute of	Applied Physics	Faculty of Physics a	and Astronomy		
ECTS		l of grading	<u> </u>	c. compl. of module(s)			
6		cal grade					
Duratio	on /	Nodule level	Other prerequisites				
1 seme	ester g	graduate					
Conten	nts						
topics sound	are conv	entional X-ray techniq omography. The lectu	ue, computer tomogra	phy, imaging technic	cation in Biomedicine. The ma ques of nuclear medicine, ultr ory of imaging systems and d		
Intend	ed learni	ng outcomes					
derstar images	nd the pr s.	inciples of image gen	eration and are able to	explain different teo	ication in Biomedicine. They the characteristic cha		
		number of weekly con	tact hours, language –	- If other than Germa	in)		
V (3) + Module	• •	in: German or English					
			language — if other th	an German, evamina	tion offered — if not every ser		
			can be chosen to earn				
c) oral d) proje e) pres If a writ stead t of asse nation Langua Assess	examina ect repor sentation itten exar take the f essment date at t age of as sment off	tion in groups (groups t (approx. 8 to 10 pag /talk (approx. 30 min nination was chosen form of an oral examin is changed, the lectur he latest. sessment: German an ered: In the semester	utes) as method of assessm lation of one candidate er must inform student	tes per candidate) o ent, this may be cha e each or an oral exa s about this by four	nged and assessment may in- mination in groups. If the met weeks prior to the original exa		
Allocat	tion of pl	aces					
Additio	onal info	mation					
Worklo	oad						
180 h							
Teachi	ing cycle						
Referre	ed to in L	POI (examination reg	gulations for teaching-	degree programmes)			
Modul	e appear	- •					
Mouul		s in					
Master Master Master	r's degree r's teachi	e (1 major) Physics (20 e (1 major) Functional ng degree Gymnasiun	Materials (2016)		ork Bavaria (ENB) (2016) B) (2016)		

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Functional Materials (2022)

exchange program Physics (2023)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 71 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title					Abbreviation		
Models Beyond the Standard Model of Elementary Particle Physics					11-BSM-161-m01		
Module coordinator				Module offered by			
Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics			ind Astronomy				
ECTS	Metho	od of grading	Only after succ. con	compl. of module(s)			
6	nume	rical grade					
Duratio	n	Module level	Other prerequisites	i			
1 semester		graduate					
Conten	ts						
2. Tests 3. Neut	 Principles of the standard model of Elementary Particle Physics Tests of the standard model in low energy experiments and at high energy colliders Neutrino physics Higgs physics. 						
 In addition, a selection of topics from the following fields will be covered in different years: Phenomenology of experiments at the LHC, particle cosmology, extended gauge theories, models with extended Higgs sectors, supersymmetry, models with additional space-time dimensions 							
Intende	ed learr	ning outcomes					
The students are familiar with the tests and limits of the standard model of Particle Physics, Higgs physics and neutrino physics. They are able to formulate extensions of the standard model. Furthermore, they know how to test these extensions in low energy experiments, at high energy colliders and in cosmology.							
V (3) +	Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: German or English						
	Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)						
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 							
Additional information							
Worklo	Workload						
180 h							
100 11							

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 72 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 73 / 215
, ,	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation		
Image and Signal Processing in Physics				11-BSV-161-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. co		npl. of module(s)			
6 numerical grade					
Duration					
1 semester	graduate				
Contents					
and image pro convolution p	aperiodic signals; princip ocessing; discretisation o roduct; tapering functior tion; statistical signals, i n.	of signals/sampling the signals of signals of the second sec	neorem (Shannon); ł f images; the Parsiva	nomogeneous and li al theorem, correlation	near filters, on and ener-
Intended lear	ning outcomes				
les of image p	have advanced knowled processing and are famili Is and to implement ther	ar with different meth	ods of signal proces		
Courses (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (2) + Ü (2) Module taugh	t in: German or English				
	sessment (type, scope, la ion on whether module c			tion offered — if not	every seme-
b) oral examin c) oral examin d) project rep e) presentation If a written ex stead take the of assessmen nation date at Language of a Assessment of	ssessment: German and ffered: In the semester i	each (approx. 30 minu of 2, approx. 30 minu s) or tes). s method of assessme ation of one candidate r must inform student //or English	tes per candidate) of ent, this may be char e each or an oral exa is about this by four	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocation of	places	_			
Additional inf	ormation				
Workload					
180 h					
Teaching cycl	e				
Referred to in	LPOI (examination regu	ulations for teaching-o	degree programmes)		
Module appea	ars in				
Master's degr	ee (1 major) Mathematic ee (1 major) Physics (201 ee (1 major) Nanostructu	.6)			
Master's with 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 •		page 74 / 215
		reg. data rec	cord Master (120 ECTS) Physil	(-2016	

UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Module title			Abbreviation			
Bosonisation and Interactions in One Dimension			11-BWW-161-m01			
Module	e coord	inator		Module offered by	Module offered by	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics a	and Astronomy			
ECTS Method of grading Only after succ. compl. of module(s)						
6 numerical grade						
Duratio	ion Module level Other prerequisites					
1 seme	ster	graduate				
Conten	ts					
2.Abeli malizat The bel 3.Intera	an bos ion gro ow me acting f	up, and the sine-Gord ntioned topics will be p ermions on a lattice (H	r liquids (spinless ferm	vears:		spin, renor-
7.Non-a lodchik	1/2 cha dered s abelian ov equ	ains systems bosonisation and the ation, applications of t	WZW model (Kac-Mood he WZW model)	dy algebras, Sugawa	ra construction, Kniz	hnik-Zamo-
Intende	ed learn	ning outcomes				
			ne peculiarities of one- omena relevant to exp			
Course	s (type	, number of weekly cor	itact hours, language –	– if other than Germa	an)	
V (3) + Module		t in: German or English				
			language — if other th can be chosen to earn		ation offered — if not	every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachir	ng cycl	9				
Master's wi	th 1 major	Physics (2016)		urg • generated 19-Apr-2025 cord Master (120 ECTS) Physi		page 76 / 215

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

Module appears in

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 77 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Computational Materials Science (DFT)				11-CMS-161-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. o			npl. of module(s)			
8 numerical grade						
Duratio	n	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
2. Wann 3. Num 4. Hartr 5. Many 6. Ande 7. Dyna 8. DFT -	nier fur erical e ree-Foc y-body erson ir mical r + DMFT	ctional theory (DFT) nctions and localized ba evaluation of topologica k and static mean-field methods for solid state npurity model (AIM) an nean-field theory (DMF methods for realistic m rrelated electrons	al invariants theory e physics d Kondo physics T)			
-		ning outcomes	_			
pool. Th constru the soft serve b me qua (DMFT).	ne part action c tware w order c antum <i>N</i> . These	e theoretical discussion icipants are introduced of maximally localised w vannier90. Furthermore ases such as the Kond Monte Carlo are utilised steps are necessary to metal oxide such as Sr	to the use of DFT softwork Vannier functions through the students learn ho o regime. Impurity solv to solve the self consist reach the peak of the	ware packages such ugh the projection of ow to construct many vers such as exact dia istency equations of	as VASP or Wien2k a DFT results on atom -particle solutions o agonalisation or con dynamic molecular f	and to the orbitals with f AIM and ob- tinuous-ti- field theory
Course	s (type	, number of weekly con	tact hours, language –	- if other than Germa	ın)	
V (4) + Module		t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
 b) oral c) oral of d) projection e) present lf a write stead ta of assent nation Langua 	examin examin ect repo entatio ten exa ake the ssmen date at ge of a	mination (approx. 90 to nation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 minu amination was chosen a form of an oral examin t is changed, the lectur the latest. ssessment: German an ffered: In the semester	each (approx. 30 minu s of 2, approx. 30 minu es) or utes). as method of assessm nation of one candidate er must inform student d/or English	ites per candidate) o ent, this may be char e each or an oral exa ts about this by four	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo						
	au					
240 h						
Master's wi	th 1 majoi	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 78 / 215

Teaching cycle

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

Module appears in Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 79 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Renorm	<u>e title</u>			_	Abbreviation	
Renormalization Group and Critical Phenomena				11-CRP-161-m01		
Module	e coord	inator		Module offered by		
			Faculty of Physics a	and Astronomy		
and As	-		,		,	
ECTS Method of grading Only after succ. compl. of module(s)						
6 numerical grade						
Duratio	-	Module level	Other prerequisites	5		
1 semester graduate						
Conten						
4. Pertu 5. Low-	n field concep urbatio dimens			grams and fixed poir	nts	
Intend	ed lear	ning outcomes				
The stu (RG) in	idents a Statist	acquire profound knowle ical Physics. They under I quantum field theory.				
Course	s (type	, number of weekly cont	act hours, language -	– if other than Germa	an)	
V (3) + Module		t in: German or English				
		sessment (type, scope, l ion on whether module o			ation offered — if not	t every seme-
b) oral	examir	mination (approx. 90 to nation of one candidate o nation in groups (groups	each (approx. 30 min	-		
d) proje e) pres If a writ stead t of asse nation Langua	ect repo entatio tten exa ake the essmen date at age of a	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres If a writ stead t of asse nation Langua	ect repo entatio tten exa ake the essmen date at age of a ment o	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres lf a writ stead t of asse nation Langua Assess	ect repo entatio tten exa ake the essmen date at age of a ment o	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat	ect repo entatio tten exa ake the essmen date at age of a sment o :ion of j	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat	ect rep entatio tten exa cake the essmen date at age of a ment o cion of j	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i places	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio	ect rep entatio tten exa cake the essmen date at age of a ment o cion of j	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i places	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
d) proje e) pres If a writ stead t of asse nation Langua Assess Allocat Additio	ect rep entatio tten exa cake the essmen date at age of a ment o cion of p onal inf	ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester i places ormation	s) or tes). s method of assessm ation of one candidat r must inform studen I/or English	ent, this may be cha e each or an oral exa ts about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
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UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 81 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

	e title				Abbreviation	
Advanc	ed Top	oics in Astrophysics			11-CSAM-161-m01	
		•				
Module coordinator				Module offered by		
and Astrophysics				Faculty of Physics a	and Astronomy	
ECTS		od of grading	Only after succ. compl. of module(s)			
6						
DurationModule levelOther prerequisites1 semestergraduateApproval from examination committee required.						
1 seme	ster	graduate	Approval from exan	nination committee r	equired.	
Conten	ts					
include	e: Stella	y of particular current top ar structure, formation an the interstellar medium, a	id development, radi	ation transport, gas	dynamics, heating a	nd cooling
Intende	ed lear	ning outcomes				
The stu scientif		have advanced knowled§ stions.	ge of the subdisciplir	nes of Astrophysics a	nd are able to work o	on current
Course	s (type	, number of weekly conta	act hours, language –	– if other than Germa	un)	
V (3) +						
-		sessment (type, scope, la	anguage — if other th	an German, examina	tion offered — if not	every seme-
		ion on whether module c				
		ort (approx. 8 to 10 pages		ıtes per candidate) o	r	
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Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 83 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Advand	ed Top	ics in Solid State Physi	cs		11-CSFM-161-m01	
Module	o coordi	inator		Module offered by		
Managing Director of the Institute of Theoretical Physics			Faculty of Physics a	and Astronomy		
and As	-		neoreticat i nysics		and Astronomy	
ECTS						
6		rical grade				
Duration Module level Other prerequisites						
1 semester graduate Approval from examination committee required.						
Conten	ts					
vered i	n any o	vill enable the lecturers f the other modules. Th n the regular curriculum	ese topics may relate			
Intende	ed learr	ning outcomes				
		advance their knowledg sights into the connect			of Condensed Matt	er Physics
Course	s (type,	, number of weekly con	tact hours, language -	– if other than Germa	in)	
V (3) +	R (1)					
		essment (type, scope,			ition offered — if not	every seme-
ster, in	formati	on on whether module	can be chosen to earr	n a bonus)		
If a writ stead t of asse nation Langua	tten exa ake the ssment date at ge of a	n/talk (approx. 30 minu amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: German an	as method of assessm ation of one candidat er must inform studen	e each or an oral exa	mination in groups.	If the method
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	9				
Referre	d to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module	e appea	in				
Master	's degre	ee (1 major) Physics (20	16)			
	-	ee (1 major) Nanostruct				
		ning degree Gymnasium				016)
		y course MINT Teacher es (Master) Physics (201		Network Bavaria (EN	в) (2016)	
		ee (1 major) Nanostruct	-)		
	-	ee (1 major) Physics (20)		
	-	Physics (2016)	JMU Würzb	ourg • generated 19-Apr-2025		page 84 / 215
			rog data re	ecord Master (120 ECTS) Physi	1	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 85 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation		
Introduction	to Fractional Quantisat	ion		11-EFQ-161-m01	
Module coord	linator		Module offered by	<u> </u>	
Managing Dir and Astrophy	ector of the Institute of sics	Theoretical Physics	Faculty of Physics a	ind Astronomy	
i (od of grading	Only after succ. con	npl. of module(s)		
L	erical grade				
Duration	Module level	Other prerequisites	;		
1 semester	graduate				
Contents					
The course will elaborate on instances of fractional quantisation in nature, mostly employing examples from the following list:					
	tes in polyacethylene antised Hall states (Lau s theory)	ghlin states, fractional	charge and statistic	s, hierarchy states, e	effective
3. Non-Abelia states)	n quantised Hall states	(Pfaffian states, Major	rana fermions, non-A	belian statistics, Rea	ad-Rezayi
Yangian symr	4. Spin chains (Haldane-Shastry model, spinon excitations, holon excitations in the Kuramoto-Yokoyama model, Yangian symmetry)5. Chiral spin liquids (Abelian and non-Abelian) 6. Kitaev models (toric code model, honeycomb model).				
		on-Abelian) 6. Kitaev m	odels (toric code mo	del, noneycomb mo	del).
	ning outcomes			was and with Andrea	anla nhilana
phical princip	The students become familiar with emergent phenomena in many-particle systems and with Anderson's philoso- phical principle of "More is different" by studying specific examples of quantum condensates exhibiting fractio- nal quantisation.				
Courses (type	e, number of weekly cor	itact hours, language –	- if other than Germa	ın)	
V (3) + R (1)					
	nt in: German or English				
ster, informat	sessment (type, scope, ion on whether module	can be chosen to earn		tion offered — if not	every seme-
	mination (approx. 90 to nation of one candidate		utes) or		
	nation in groups (group		tes per candidate) o	r	
	ort (approx. 8 to 10 pag on/talk (approx. 30 min				
	amination was chosen		ent, this may be cha	nged and assessmer	nt may in-
stead take th	e form of an oral exami	nation of one candidate	e each or an oral exa	mination in groups.	If the method
of assessmer nation date a	nt is changed, the lectur	er must inform studen	ts about this by four	weeks prior to the or	riginal exami-
	assessment: German ar	ıd/or English			
	offered: In the semester		offered and in the su	ubsequent semester	
Allocation of	places				
Additional in	formation				
Workload					
180 h					
Teaching cyc	le				
Master's with 1 majo	or Physics (2014)	INALI \\\//:		evam	page 96 / arr
master s with 1 maj	1 1 11ySICS (2010)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 86 / 215

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

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 87 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation
Gauge					11-EIT-161-m01
Module	coordi	nator		Module offered by	
Managi and Ast	-	ctor of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS		d of grading	Only after succ. con	pl. of module(s)	
6	numer	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Content	ts				
	The main topic of the course will usually be lattice gauge theories. The concepts may be taught and illustrated by elaborating on the role of lattice gauge theories in spin systems.				
1. Introc 2. Phase 3. The tr 4. The tr	duction e trans ransfer wo-dim	matrix nensional (2D) Ising mod			
 5. Ising lattice gauge theory 6. Abelian lattice gauge theories 7. The planar Heisenberg (XY) model in 2D (Kosterlitz-Thouless transition) 8. Non-Abelian lattice gauge theories 					
Intende	d learr	ning outcomes			
The students acquire in-depth understanding of gauge fields in classical and Quantum Physics. They are able to apply this knowledge to spin systems, illustrating the interplay between microscopic models and field-theoretic descriptions.					
Courses	s (type,	number of weekly conta	ct hours, language –	- if other than Germa	n)
V (3) + F Module		t in: German or English			
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English 					
Assessr Allocati		ffered: In the semester in	which the course is	offered and in the su	bsequent semester
	511 OI P				
Additio	nal info	ormation			
Workloa	ad				
180 h					

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 88 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 89 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Introdu	iction t	o Plasma Physics			11-EPP-161-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of ics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	;		
1 seme	ster	graduate				
Conten	ts					
transpo thin the	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 wi- thin the solar wind, particle acceleration via shock waves and via interaction with plasma turbulence, particle ac- celeration and transport in galaxies and other astrophysical objects, cosmic radiation.					
Intende	ed learn	ning outcomes				
The stu	dents ł	nave knowledge of the	basic processes of Pla	sma Astrophysics.		
Course	s (type,	, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (2) + Module		t in: German or English				
Method	d of ass	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
		on on whether module				,
 c) oral e d) proje e) prese lf a writ stead ta of asse nation Langua 	examin ect repo entatio ten exa ake the ssment date at ge of a	ation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 minu amination was chosen a form of an oral examin t is changed, the lectur the latest. ssessment: German an ffered: In the semester	s of 2, approx. 30 minu es) or utes) as method of assessm ation of one candidate er must inform student d/or English	ites per candidate) of ent, this may be char e each or an oral exa ts about this by four	nged and assessmer mination in groups. I weeks prior to the or	If the method riginal exami-
Allocat					•	
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachir		9				
reaciiii	IS CYC	5				
Deferre	d to in	IDOL (avamination rad	ulations for too shing			
Referre		LPOI (examination reg		degree programmes)		
Module						
Master' Master' Supple	's degre 's teach mentar	ee (1 major) Physics (20 ee (1 major) Mathemati ning degree Gymnasiun y course MINT Teacher ee (1 major) Physics (20	cal Physics (2016) n MINT Teacher Educat Education PLUS, Elite			016)
Master's wi	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 90 / 215

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 91 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title			Abbreviation	
Current	Topics in Experimental Physic	s		11-EXE5-161-m01	
Madula			Madula offered by		
	coordinator		Module offered by		
<u> </u>	rson of examination committee		Faculty of Physics a	ind Astronomy	
i	Method of grading	Only after succ. con	ipl. of module(s)		
5	numerical grade				
Duratio		Other prerequisites	······	i I	
1 semes		Approval from exam	Ination committee n	equirea.	
Content					
Current study a	topics in experimental physics broad.	. Credited academic a	achievements, e.g. ir	n case of change of u	university or
Intende	ed learning outcomes				
sics of t derstan	dents have advanced competer the Master's programme. They h d the measuring and/or evalua ubject-specific contexts and kn	nave knowledge of a dition methods necess	current subdiscipline ary to acquire this k	e of Experimental Ph	ysics and un-
Courses	s (type, number of weekly conta	act hours, language –	if other than Germa	in)	
V (2) + F	R (2)				
Method	l of assessment (type, scope, la	anguage — if other th	an German, examina	tion offered — if not	every seme-
	formation on whether module c				,
e) prese If a writt stead ta of asses nation o Langua	ect report (approx. 8 to 10 pages entation/talk (approx. 30 minut ten examination was chosen as ake the form of an oral examina ssment is changed, the lecture date at the latest. ge of assessment: German and ion of places	es) s method of assessmo tion of one candidate r must inform student	each or an oral exa	mination in groups.	If the method
Additio	nal information				
Additio					
Workloa	ad				
	au				
150 h					
Teachin	ig cycle				
Referre	d to in LPO I (examination regu	llations for teaching-	legree programmes)		
Module	appears in				
Master' Suppler Module Master' Master'	s degree (1 major) Physics (201 s teaching degree Gymnasium mentary course MINT Teacher E studies (Master) Physics (2019 s degree (1 major) Physics (202 s teaching degree Gymnasium mentary course MINT Teacher E	MINT Teacher Educat ducation PLUS, Elite)) :0) MINT Teacher Educat	Network Bavaria (EN on PLUS, Elite Netw	B) (2016) ork Bavaria (ENB) (20	
	th 1 major Physics (2016)	JMU Würzbı	rg • generated 19-Apr-2025	• exam.	page 92 / 215
		reg. data rec	ord Master (120 ECTS) Physi	k - 2016	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 93 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module t	title			Abbreviation	
Current 1	Topics in Experimental Physics	5		11-EXE6-161-m01	
Madula	coordinator		Modulo offered bee		
			Module offered by	u d A stur u	
	son of examination committee	Outra francisco a su	Faculty of Physics a	ind Astronomy	
	Method of grading numerical grade	Only after succ. com	pl. of module(s)		
Duration 1 semest		Other prerequisites Approval from exam	ination committee r	aguirod	
	3			equileu.	
Contents					
Current t study ab	opics in experimental physics. road.	. Credited academic a	ichievements, e.g. ir	n case of change of u	iniversity or
Intended	l learning outcomes				
sics of th derstand	ents have advanced competer ne Master's programme. They h I the measuring and/or evalua bject-specific contexts and kno	nave knowledge of a c tion methods necess	current subdiscipline ary to acquire this ki	e of Experimental Phy	ysics and un-
Courses	(type, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (3) + R	(1)				
	of assessment (type, scope, la prmation on whether module ca			tion offered — if not	every seme-
If a writte stead tak of assess nation da Languag Allocatio	ntation/talk (approx. 30 minute en examination was chosen as ke the form of an oral examina sment is changed, the lecturer ate at the latest. e of assessment: German and, on of places al information	method of assessme tion of one candidate must inform student	each or an oral exa	mination in groups.	If the method
Workloa	d				
180 h					
Teaching	g cycle				
<u>_</u>					
Referred	to in LPO I (examination regu	lations for teaching-c	legree programmes)		
Module a	appears in				
Master's Supplem Modules Master's Master's	degree (1 major) Physics (201 teaching degree Gymnasium / nentary course MINT Teacher Ed studies (Master) Physics (2019 degree (1 major) Physics (202 teaching degree Gymnasium / nentary course MINT Teacher Ed	MINT Teacher Educati ducation PLUS, Elite I) o) MINT Teacher Educati	Vetwork Bavaria (EN on PLUS, Elite Netwo	B) (2016) ork Bavaria (ENB) (20	
	1 major Physics (2016)	JMU Würzbu	rg • generated 19-Apr-2025 •	exam.	page 94 / 215
		reg. data rec	ord Master (120 ECTS) Physil	K - 2016	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 95 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation	
Current Topic	s in Experimental Phys	ics		11-EXE6A-161-m01	
Module coord	linator		Module offered by	<u> </u>	
	· · · · · · · · · · · · · · · · · · ·				
· · ·	of examination committ		Faculty of Physics a	ind Astronomy	
	od of grading erical grade	Only after succ. con	ipi. of module(s)		
I	T				
Duration	Module level	Other prerequisites		:	
1 semester	graduate	Approval from exam	ination committee r	equirea.	
Contents					
Current topics study abroad	s in experimental physi •	cs. Credited academic	achievements, e.g. ir	ו case of change of נ	iniversity or
Intended lear	rning outcomes				
sics of the Ma derstand the	have advanced compe aster's programme. The measuring and/or eval t-specific contexts and	y have knowledge of a uation methods necess	current subdiscipline ary to acquire this ki	e of Experimental Ph	ysics and un-
Courses (type	e, number of weekly cor	ntact hours, language –	- if other than Germa	in)	
V (3) + R (1)					
Method of as	sessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
	tion on whether module				,
If a written ex stead take th of assessmer nation date a	on/talk (approx. 30 min amination was chosen e form of an oral exami nt is changed, the lectu t the latest. assessment: German ar	as method of assessm nation of one candidate rer must inform student	e each or an oral exa	mination in groups.	If the method
Allocation of	places				
Additional in	formation				
Workload					
180 h					
Teaching cyc	ام				
reaching cyc					
Doforred to in	IDOI (overside the	gulations for toaching	dograa programme)		
	LPOI (examination re	gulations for teaching-	legree programmes)		
	•				
Module appe					
Master's tead	ree (1 major) Physics (2				
Module studi Master's deg Master's teac	ry course MINT Teacher es (Master) Physics (20 ree (1 major) Physics (2 ching degree Gymnasium	Education PLUS, Elite 19) 020) m MINT Teacher Educat	Network Bavaria (EN ion PLUS, Elite Netwo	ork Bavaria (ENB) (24	
Module studi Master's deg Master's teac	ry course MINT Teacher es (Master) Physics (20 ree (1 major) Physics (2 ching degree Gymnasiun ry course MINT Teacher	Education PLUS, Elite 19) 020) m MINT Teacher Educat Education PLUS, Elite	Network Bavaria (EN ion PLUS, Elite Netwo	B) (2016) ork Bavaria (ENB) (24 B) (2020)	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 97 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation	
Current Topic	s in Experimental Physic	S		11-EXE7-161-m01	
Madula asar	lington		Madula offered by		
Module coord			Module offered by		
	f examination committee		Faculty of Physics a	ind Astronomy	
	od of grading	Only after succ. con	ipl. of module(s)		
· .	rical grade				
Duration	Module level	Other prerequisites			
1 semester	graduate	Approval from exam	ination committee re	equired.	
Contents					
Current topics study abroad	s in Experimental Physics	. Credited academic a	achievements, e.g. ir	η case of change of ι	iniversity or
Intended lear	ning outcomes				
sics of the Ma derstand the	have advanced compete ister's programme. They measuring and/or evalua -specific contexts and kn	have knowledge of a oution methods necess	current subdiscipline ary to acquire this ki	e of Experimental Ph	ysics and un-
Courses (type	e, number of weekly conta	act hours, language –	if other than Germa	in)	
V (3) + R (1)					
Method of as	sessment (type, scope, la			tion offered — if not	every seme-
ster, informat	ion on whether module c	an be chosen to earn	a bonus)		
e) presentation If a written ex stead take the of assessment nation date a	ort (approx. 8 to 10 page on/talk (approx. 30 minut amination was chosen as e form of an oral examina it is changed, the lecture t the latest. assessment: German and	tes) s method of assessme ttion of one candidate r must inform student	e each or an oral exa	mination in groups.	If the method
Allocation of	places				
Additional inf	ormation				
Workload					
210 h					
Teaching cyc					
 Referred to in	LPOI (examination regu	lations for teaching-	legree programmes)		
Module appe	ars in				
	ree (1 major) Physics (201	6)			
Master's teac Supplementa Module studi Master's degr Master's teac	hing degree Gymnasium ry course MINT Teacher E es (Master) Physics (2019 ree (1 major) Physics (202 hing degree Gymnasium ry course MINT Teacher E	MINT Teacher Educat ducation PLUS, Elite I 9) 20) MINT Teacher Educat	Network Bavaria (EN ion PLUS, Elite Netwo	B) (2016) ork Bavaria (ENB) (24	
Master's with 1 majo		JMU Würzbı	irg • generated 19-Apr-2025 •	• exam.	page 98 / 215
			ord Master (120 ECTS) Physil		



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 99 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title			Abbreviation	
Current	t Topics in Experimental Phys	cs		11-EXE8-161-m01	
Module	e coordinator		Module offered by		
	erson of examination committee	20	Faculty of Physics a	and Astronomy	
ECTS	Method of grading	Only after succ. con		inu Astronomy	
8	numerical grade				
Duratio		Other prerequisites			
1 seme	· · · · · · · · · · · · · · · · · · ·		ination committee re	equired.	
Conten		[, ipprovation exam		equireat	
	t topics in experimental physic	s. Credited academic	achievements, e.g. ir	ו case of change of נ	university or
Intende	ed learning outcomes				
sics of derstar	idents have advanced compet the Master's programme. They nd the measuring and/or evalu subject-specific contexts and k	have knowledge of a ation methods necess	current subdiscipline ary to acquire this ki	e of Experimental Ph	ysics and un-
Course	s (type, number of weekly con	tact hours, language –	- if other than Germa	in)	
V (4) +	R (2)				
	d of assessment (type, scope, formation on whether module	5 5		tion offered — if not	every seme-
If a writ stead t of asse nation	entation/talk (approx. 30 min tten examination was chosen a ake the form of an oral examir essment is changed, the lectur date at the latest. age of assessment: German an	as method of assessm lation of one candidate er must inform student	e each or an oral exa	mination in groups.	If the method
Allocat	ion of places				
Additio	onal information				
Worklo	ad				
240 h					
	ng cycle				
Teacini					
Referre	d to in LPO I (examination reg	ulations for teaching.	legree programmes)		
Module	e appears in				
	's degree (1 major) Physics (20	016)			
Master Supple Module Master	's teaching degree Gymnasiun mentary course MINT Teacher e studies (Master) Physics (20 's degree (1 major) Physics (20 's teaching degree Gymnasiun	n MINT Teacher Educat Education PLUS, Elite 19) 120)	Network Bavaria (EN	B) (2016)	
	mentary course MINT Teacher				- /
	ith 1 major Physics (2016)	JMU Würzbi	irg • generated 19-Apr-2025 •	• exam.	page 100 / 215
		reg. data re	cord Master (120 ECTS) Physil	K - 2016	



Masteria with a major Dhusica (asa)		
Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 101 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

M	e title			_	Abbreviation
Nonph	ysical I	Minor Subject			11-EXNP6-161-m01
Modul	e coord	inator		Module offered by	
chairp	erson o	f examination committee	!	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	ompl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	graduate	Approval from exam	ination committee r	equired.
Conter	nts				
Non-te	chnica	minor. Crediting for acad	demic achievements,	e.g. from university	change or study abroad
Intend	ed lear	ning outcomes			
		have advanced competer ld of a non-physical mind			ond to the requirements of a mo- .).
Course	es (type	, number of weekly conta	act hours, language –	- if other than Germa	an)
V (3) +					
Metho	d of as	sessment (type, scope, la ion on whether module c			ation offered — if not every seme-
lf a wri stead t	tten ex take the	n/talk (approx. 30 minut	es)		
nation	date at	e form of an oral examina	s method of assessme tion of one candidate must inform student	e each or an oral exa	
nation Langua	date at	e form of an oral examina t is changed, the lecture t the latest. Issessment: German and	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the method
nation Langua Allocat	date at age of a tion of [e form of an oral examina t is changed, the lecture t the latest. Issessment: German and	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the metho
nation Langua Allocat	date at age of a tion of [e form of an oral examina t is changed, the lecture t the latest. ssessment: German and places	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the method
nation Langua Allocat	date at age of a tion of onal inf	e form of an oral examina t is changed, the lecture t the latest. ssessment: German and places	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the metho
nation Langua Allocat Additic	date at age of a tion of onal inf	e form of an oral examina t is changed, the lecture t the latest. ssessment: German and places	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the metho
nation Langua Allocat Additio Worklo 180 h	date at age of a tion of onal inf	e form of an oral examina t is changed, the lecturer t the latest. Issessment: German and places	s method of assessme tion of one candidate must inform student	e each or an oral exa	nged and assessment may in- mination in groups. If the method weeks prior to the original exami
nation Langua Allocat Additio Worklo 180 h	date at age of a tion of p onal inf	e form of an oral examina t is changed, the lecturer t the latest. Issessment: German and places	s method of assessme tion of one candidate must inform student	e each or an oral exa	mination in groups. If the method
nation Langua Allocat Additio Worklo 180 h Teachi 	date at age of a tion of onal inf oad	e form of an oral examina t is changed, the lecturer t the latest. Issessment: German and places	s method of assessmo tion of one candidate must inform student /or English	e each or an oral exa	mination in groups. If the method weeks prior to the original exami
nation Langua Allocat Additio Worklo 180 h Teachi 	date at age of a tion of onal inf oad	e form of an oral examina t is changed, the lecturer t the latest. issessment: German and places	s method of assessmo tion of one candidate must inform student /or English	e each or an oral exa	mination in groups. If the methor weeks prior to the original exami
nation Langua Allocat Additio 180 h Teachi Referre	date at age of a tion of onal inf oad	e form of an oral examina t is changed, the lecturer t the latest. Issessment: German and places formation e LPO I (examination regu	s method of assessmo tion of one candidate must inform student /or English	e each or an oral exa	mination in groups. If the method weeks prior to the original exami
nation Langua Allocat Additio Worklo 180 h Teachi Referre Modulo	date at age of a tion of p onal inf oad ng cycl ed to in e appea	e form of an oral examina t is changed, the lecturer t the latest. Issessment: German and places formation e LPO I (examination regu	s method of assessmo tion of one candidate must inform student /or English 	e each or an oral exa	mination in groups. If the method weeks prior to the original exami

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 102 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title Abbreviation						
Curren	t Topics	s in Physik			11-EXP6-161-m01	
Modul	e coord	inator		Module offered by		
chairp	erson of	f examination committee		Faculty of Physics a	nd Astronomy	
ECTS		od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Durati	on	Module level	Other prerequisites			
1 seme	ester	graduate	Approval from exam	ination committee re	equired.	
Conter	nts					
		in experimental or theor tudy abroad.	etical physics. Credit	ed academic achieve	ements, e.g. in case	of change of
Intend	Intended learning outcomes					
Theore subdis	tical Ph cipline	nave advanced competer ysics of the Master's pro of Physics and understar ney are able to classify th	gramme of Nanostruend the measuring and	cture Technology. Th I/or calculation meth	ey have knowledge of nods necessary to ac	of a current
Course	es (type,	, number of weekly conta	ct hours, language –	- if other than Germa	n)	
V (3) +	R (1)					
		e ssment (type, scope, la on on whether module ca			tion offered — if not	every seme-
d) proj e) pres If a wri stead t of asse nation Langua	ect repo entatio tten exa take the essment date at age of a	ation in groups (groups of ort (approx. 8 to 10 pages n/talk (approx. 30 minut amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: German and,	s) or es) method of assessmo tion of one candidate must inform student	ent, this may be char e each or an oral exa	nged and assessmer mination in groups.	If the method
Alloca	tion of p	olaces				
Additio	onal info	ormation				
Worklo	oad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)		
Modul	e appea	ars in				
Master Master Supple Modul Master Master	r's degre r's teach ementar e studie r's degre	ee (1 major) Physics (201 ee (1 major) Nanostructur ning degree Gymnasium I y course MINT Teacher E es (Master) Physics (2019 ee (1 major) Nanostructur ee (1 major) Physics (202	re Technology (2016) MINT Teacher Educat ducation PLUS, Elite I) re Technology (2020) o)	Network Bavaria (EN	B) (2016)	
Master's w	nth 1 major	Physics (2016)		rrg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 103 / 215

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 104 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Current Topics in Physik 11:EXP6A-161-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) Ouration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Corrent Corrent topics in Experimental or Theoretical Physics. Credited 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 or Theoretical Physics of the Master's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation 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 (3) + R (1) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information in groups, groups of a, approx. 30 minutes) or or or ale axmination of one candidate each (approx. 30 minutes) or or or ale axmination of one candidate each or an or ale axmination in groups. If the method of assessment, this may be changed and assessment may in-prostead take the form of an oral examination an groups. If the method of assessment, this may be cha	Module					Abbreviation	
chairperson of examination committee Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade		-	-			11-EXP6A-161-m01	
ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Conternts	Module	e coord	inator		Module offered by		
6 numerical grade	chairpe	erson of	f examination committee		Faculty of Physics a	nd Astronomy	
Duration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Contents Contents Contents Current topics in Experimental or Theoretical Physics. Credited 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 or Theoretical Physics of the Master's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation 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, examination offered — if not every semester, information on whether module can be chosen to eam a bonus) a) written examination of one candidate each (approx. 30 minutes) or o) col ale examination in groups (groups of 2, approx. 30 minutes) or o) col ale examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment: German and/or English Alduational information	ECTS			Only after succ. con	pl. of module(s)		
1 semester graduate Approval from examination committee required. Contents Current topics in Experimental or Theoretical Physics. Credited 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 or Theoretical Physics of the Master's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation 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 (3) + R (1) Method of assessment (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 to 120 minutes) or b) oral examination in groups (groups of 2, approx, 30 minutes) or c) oral examination in groups (groups of 2, approx, 30 minutes) or c) oral examination in groups (groups of 2, approx, 30 minutes per candidate) or d) project report (approx, 30 minutes) if a written examination as chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Allocation of places	6	nume	rical grade				
Contents Current topics in Experimental or Theoretical Physics. Credited 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 or Theoretical Physics of the Master's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation 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 (3) + R (1) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 9 to 120 minutes) or b) oral examination on groups (groups of 2, approx. 30 minutes) pr b) oral examination on groups (groups of 2, approx. 30 minutes) or b) oral examination on a candidate each (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment. German and/or English Allocation of places	Duratio	on					
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		-		JMU Würzbı			page 105 / 215

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 106 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title			Abbreviation	
Current	Topics of Theoretical Physics			11-EXT5-161-m01	
Module	coordinator		Module offered by		
	son of examination committee		Faculty of Physics a	and Astronomy	
· · · ·	Method of grading	Only after succ. con	· · · · · · · · · · · · · · · · · · ·	inu Astronomy	
	numerical grade				
Duration		Other prerequisites			
1 semest		Approval from exam		equired	
Contents				equirea.	
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study ab			nevements, e.g. in c	ase of change of un	iversity of
Intended	l learning outcomes				
sics of th sics and	ents have advanced compete ne Master's programme. They have mastered the required r etical Physics.	have advanced specia	alist knowledge of a	subdiscipline of The	oretical Phy-
Courses	(type, number of weekly cont	act hours, language –	if other than Germa	in)	
V (2) + R	(2)				
Method	of assessment (type, scope, l	anguage — if other tha	an German, examina	tion offered — if not	every seme-
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Addition	al information	_			
		_			
Workloa	d				
150 h					
Teaching	g cycle				
Referred	to in LPO I (examination reg	ulations for teaching-o	legree programmes)		
Module	appears in				
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	1 major Physics (2016)	JMU Würzbı	irg • generated 19-Apr-2025 •	• exam.	page 107 / 215
		reg. data rec	cord Master (120 ECTS) Physil	k - 2016	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 108 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title Current Topics of Theoretical Physics	Abbreviation
	11-EXT6-161-m01
	offered by
	f Physics and Astronomy
ECTS Method of grading Only after succ. compl. of mo	dule(s)
6 numerical grade	
Duration Module level Other prerequisites	
1 semester graduate Approval from examination co	ommittee required.
Contents	
Current topics in theoretical physics. Credited academic achievement study abroad.	s, e.g. in case of change of university or
Intended learning outcomes	
The students have advanced competencies corresponding to the required of the Master's programme. They have advanced specialist know sics and have mastered the required methods. They are able to apply of Theoretical Physics.	ledge of a subdiscipline of Theoretical Phy-
Courses (type, number of weekly contact hours, language — if other t	han German)
V (3) + R (1)	
Method of assessment (type, scope, language — if other than Germa ster, information on whether module can be chosen to earn a bonus)	n, examination offered — if not every seme-
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Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 110 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title			Abbreviation	
Current	t Topics of Theoretical Physic	S		11-EXT6A-161-m01	
Module	e coordinator		Module offered by	<u> </u>	
	chairperson of examination committee Faculty of Physics and Astronomy				
ECTS	Method of grading		Only after succ. compl. of module(s)		
6	numerical grade				
Duratio	· · · · · · · · · · · · · · · · · · ·	Other prerequisites			
1 seme			, nination committee re	equired.	
Conten	1	1			
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	ed learning outcomes				
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Course	s (type, number of weekly cor	itact hours, language -	– if other than Germa	n)	
V (3) +	R (1)				
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	, .				
Additio	onal information				
Worklo	ad				
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	ng cyclo				
reachill	ng cycle				
 Deferme		aulations for to a him			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
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Master Supple Module Master Master	's degree (1 major) Physics (2 's teaching degree Gymnasiur mentary course MINT Teacher e studies (Master) Physics (20 's degree (1 major) Physics (21 's teaching degree Gymnasiur mentary course MINT Teacher	n MINT Teacher Educat Education PLUS, Elite 19) 020) n MINT Teacher Educat	Network Bavaria (EN ion PLUS, Elite Netwo	B) (2016) ork Bavaria (ENB) (2	
	ith 1 major Physics (2016)	JMU Würzb	urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil	• exam.	page 111 / 215
		reg. data re	COTU Master (120 ECTS) Physil	K - 2010	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 112 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title			Abbreviation		
	Topics of Theoretical Physics			11-EXT7-161-m01		
Module coordinator Module offered by						
chairper	son of examination committe	e	Faculty of Physics a	nd Astronomy		
	Method of grading	Only after succ. con	pl. of module(s)			
7 1	numerical grade					
Duration	Module level	Other prerequisites				
1 semest	ter graduate	Approval from exam	ination committee r	equired.		
Contents	5					
Current t study ab	opics in Theoretical Physics. road.	Credited academic ac	hievements, e.g. in c	ase of change of un	iversity or	
Intended	l learning outcomes					
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Courses	(type, number of weekly cont	act hours, language –	- if other than Germa	n)		
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Allocatio	on of places					
Addition	al information					
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Referred	to in LPO I (examination reg	ulations for teaching-	legree programmes)			
Module	appears in					
Master's Supplem Modules Master's Master's	degree (1 major) Physics (20 teaching degree Gymnasium nentary course MINT Teacher studies (Master) Physics (201 degree (1 major) Physics (20 teaching degree Gymnasium nentary course MINT Teacher	MINT Teacher Educat Education PLUS, Elite 9) 20) MINT Teacher Educat	Network Bavaria (EN ion PLUS, Elite Netwo	B) (2016) ork Bavaria (ENB) (24		
	1 major Physics (2016)	JMU Würzbı	ırg • generated 19-Apr-2025 •	exam.	page 113 / 215	
		reg. data ree	ord Master (120 ECTS) Physil	< - 2016		



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 114 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation		
	s of Theoretical Physic	s	· · · · · · · · · · · · · · · · · · ·	11-EXT8-161-m01		
	•					
		Module offered by				
· · ·	of examination committ		Faculty of Physics a	nd Astronomy		
	od of grading	Only after succ. con	npl. of module(s)			
	erical grade					
Duration	Module level	Other prerequisites				
1 semester	graduate	Approval from exam	ination committee r	equired.		
Contents						
Current topic study abroad	s in Theoretical Physics	. Credited academic ac	hievements, e.g. in c	ase of change of uni	iversity or	
Intended lear	ning outcomes					
sics of the Ma	have advanced compet aster's programme. The e mastered the required l Physics.	y have advanced speci	alist knowledge of a	subdiscipline of The	oretical Phy-	
Courses (type	e, number of weekly cor	itact hours, language –	- if other than Germa	n)		
V (4) + R (2)						
	sessment (type, scope, tion on whether module			tion offered — if not	every seme-	
If a written ex stead take th of assessmen nation date a	on/talk (approx. 30 min amination was chosen e form of an oral examin nt is changed, the lectur t the latest. assessment: German ar	as method of assessm nation of one candidate rer must inform studen	e each or an oral exa	mination in groups.	If the method	
Allocation of	places					
Additional in	formation					
Workload						
240 h						
Teaching cyc	le					
i cacinity cyc						
Referred to ir	LPOI (examination re	gulations for teaching-	degree programmes)			
	-	<u> </u>				
Module appe	ars in					
	ree (1 major) Physics (20	016)				
Master's tead Supplementa Module studi Master's deg	ching degree Gymnasiur ny course MINT Teacher es (Master) Physics (20 ree (1 major) Physics (20 ching degree Gymnasiur	n MINT Teacher Educat Education PLUS, Elite 19) 520)	Network Bavaria (EN	B) (2016)		
	iry course MINT Teacher				020)	
Master's with 1 majo	or Physics (2016)		urg • generated 19-Apr-2025 •	exam.	page 115 / 215	



Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 116 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module tit				Abbreviation	
Solid Stat	e Physics 2			11-FK2-161-m01	
Module co	oordinator		Module offered by		
Managing Director of the Institute of Applied Physics Faculty of Physics and As			nd Astronomy		
	ethod of grading	Only after succ. con	npl. of module(s)		
ļl	numerical grade				
Duration	Module level	Other prerequisites	i		
1 semeste	r graduate	-			
Contents					
and excita gation of r gnetic and	cattering methods; neutror ations such as phonons an magnetic, orbital and charg d electronic properties of th ons in solids and thin films t.	d magnetic waves; reso ge order; X-ray and neu nin films and superlatti	onant elastic X-ray sc tron reflectometry; in ces; resonant inelast	attering and absorpt vestigation of the st ic X-ray scattering; i	tion; investi- ructural, ma- nvestigation
Intended l	learning outcomes				
tering, mo	nts know different modern dern scattering theory, X-r ar with the theoretical princ	ay and neutron reflecto	metry and resonant i		
Courses (t	ype, number of weekly cor	ntact hours, language –	– if other than Germa	n)	
V (4) + R (2 Module ta	2) ught in: German or English				
Method of	f assessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
	mation on whether module				
 b) oral exa c) oral exa d) project e) present lf a writter stead take of assessr nation dat Language 	examination (approx. 90 to amination of one candidate umination in groups (group report (approx. 8 to 10 pag ation/talk (approx. 30 min n examination was chosen the form of an oral exami ment is changed, the lecture te at the latest. of assessment: German ar ant offered: In the semester	e each (approx. 30 minu s of 2, approx. 30 minu ges) or utes). as method of assessm nation of one candidate rer must inform student nd/or English	ites per candidate) of ent, this may be char e each or an oral exa ts about this by four y	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocation	of places				
Additiona	linformation				
Workload					
240 h					
	Teaching cycle				
	.,				
Referred t	o in LPO I (examination re	gulations for teaching-	degree programmes)		
Module ap					
	legree (1 major) Mathemat legree (1 major) Physics (2				ſ
Master's with 1	major Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 117 / 215

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam. p	
	reg. data record Master (120 ECTS) Physik - 2016	

Module title		Abbreviation				
Solid State Spectrocopy 11-FKS-161-mo1						
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of	Institute of Applied Physics Faculty of Physics and Astronomy			
ECTS	i	od of grading	Only after succ. con		,	
6	î	rical grade	,,			
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
-		any-particle pictures of -ray spectroscopy.	electrons in solids, lig	ht-matter interaction	, optical spectrosco	py, electron
Intende	ed learr	ning outcomes				
types o	fspect	nave specific and adva roscopy and their fields in research.				
Course	s (type,	number of weekly con	tact hours, language –	- if other than Germa	n)	
V (3) + Module		t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
d) proje e) pres If a writ stead t of asse nation Langua	 c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					If the method riginal exami-
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycle	<u>م</u>				
		•				
Deferre		IDOL (avamination to				
Referre		LPOI (examination reg		legree programmes)		
 Module	annea	rs in				
		ee (1 major) Mathemati	(2016)			
	-	-				
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016)						
Master's degree (1 major) Nanostructure rectinology (2010) Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		y course MINT Teacher				- /
		Physics (2016)	JMU Würzbı	urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik	exam.	page 119 / 215

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Quantum Technology (2021)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 120 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation
Visitin	g Resea	arch			11-FPA-161-m01
Module	e coord	inator		Module offered by	
		f examination committee		Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con	· · ·	
10	1	rical grade			
Duratio	I	Module level	Other preve quicites		
Duratic	DN	graduate	Other prerequisites Approval from exam		aquirod
<u> </u>		gladuate			equired.
Conten					
					Physics. Implementation of scien
		nts including analysis an rsities or research institu		ne results, especiali	ly in the context of research visit
			105.		
		ning outcomes			
		are able to independently analyse scientific experim			rimental or Theoretical Physics,
		, number of weekly conta			an)
	J (type	, number of weekly collid	et nouis, language –		411 <i>)</i>
R (o)					
		sessment (type, scope, la ion on whether module ca			ation offered — if not every seme
				a Dollus)	
		(10 to 20 pages) ssessment: German and	/or English		
-	. –	·			
Allocat		places			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Module	e annes	ars in			
		ee (1 major) Physics (201	6)		
	-	ee (1 major) Physics (201 ee (1 major) Nanostructu	-		
	-	hing degree Gymnasium I	•, · ·	ion PLUS. Elite Netw	ork Bavaria (ENB) (2016)
		ry course MINT Teacher E			
		ee (1 major) Nanostructu			
Master	's degr	ee (1 major) Physics (202	0)		
Master	's teacl	hing degree Gymnasium	MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2020)
		ry course MINT Teacher E		Network Bavaria (EN	B) (2020)
	-	ee (1 major) Quantum Teo			
		hing degree Gymnasium			_
Cunnla	mentai	ry course MINT Teacher E			

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 121 / 215
, , , , ,		
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation
Profess	sional S	Specialization Physics			11-FS-P-161-m01
Module	e coord	inator		Module offered by	
chairpe	erson o	f examination committee		Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
15	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
					of Physics with special relevance al topics in a seminar presentati-
Intende	ed lear	ning outcomes			
a speci	al relev		ic of the Master's the	esis. They know the d	subdiscipline of Physics with current state of research in this
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)
S (4) Module	e taugh	t in: German or English			
		sessment (type, scope, la on on whether module ca			tion offered — if not every seme-
		ussion (30 to 45 minutes) ssessment: German and			
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
450 h					
Teachi	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Module	e appea	ars in			
Master	's degr	ee (1 major) Physics (201	6)		
	-	ee (1 major) Physics (202	o)		
exchan	ge prog	gram Physics (2023)			

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 122 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Field TI	heoreti	cal Aspects of Solid St	ate Physics		11-FTAS-161-m01	
Module coordinator				Module offered by		
Manag	Managing Director of the Institute of Theoretical Physics and Astrophysics			Faculty of Physics a	and Astronomy	
ECTS	<u> </u>	od of grading	Only after succ. cor	npl. of module(s)		
6		rical grade		• • • •		
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
classic theorie level k beyonc	al field s as ef Wess-2 d the Vi	theory (the Higgs mech fective descriptions of o Zumino-Witten model a rasoro algebra.	nanism), non-linear sig quantised Hall fluids a	ma models for spin on no models for spin of the models for spin of the models in the model in the model in the models in the models of the mod	ion of superconductors chains, Chern-Simons an ators, respectively, or the th a symmetry group (or	nd axion e SU(2)
Intend	ed lear	ning outcomes				
		acquire an in-depth und of Condensed Matter F		n field theory and its	fundamental important	ce for al-
Course	s (type	, number of weekly con	itact hours, language -	- if other than Germa	in)	
V (3) +						
		t in: German or English				
		sessment (type, scope, ion on whether module			ition offered — if not eve	ery seme
e) pres If a writ stead t of asse nation Langua	entatio tten ex ake the essmen date at age of a	e form of an oral examir	utes). as method of assessm nation of one candidate rer must inform studen nd/or English	e each or an oral exa ts about this by four	nged and assessment m mination in groups. If th weeks prior to the origir ubsequent semester	e metho
Allocat	ion of	places				
Additio	onal inf	ormation				
Worklo	ad					
180 h	-					
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
		•				
Module						
	-	ee (1 major) Mathemati ee (1 major) Physics (20				
	-	ee (1 major) Mathemati				
	5					
Aaster's w	ith 1 maio	r Physics (2016)	IMU Würzb	urg • generated 19-Apr-2025	• exam. pa	ge 123 / 215

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 124 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title Abbreviation						
Field Th	Field Theory in Solid State Physics 11-FTFK-161-m01					
Module	e coord	inator	Module offered by	Nodule offered by		
Managi and Ast	-	ector of the Institute of sics	Theoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites	;		
1 seme	ster	graduate				
Conten	ts					
This will outline 1. Cohe 2. The f 3. Pertu 4. Orde 5. Gree 6. The I 7. Furth Intende The stu le syste Course V (4) + Module Ster, ini a) writt b) oral c) oral c d) proje e) press If a writt stead ta of asse nation Langua	Il usual could rent st. function r parar n's fun andau er deve ed learn dents a ems. Th s (type R (2) e taugh d of ass formati examin ect repo entatioo tan examin ect repo entatio stan examin ect repo entatio date at ge of a ment o	ates and review of seconal integral formalism and heory at T=0 neters and broken symethy at theory of Fermi liquids and broken symethy of Fermi liquids and the second sec	e modern methods of p ent the traditional met metry e modern methods of p ent the traditional met tact hours, language – language — if other th can be chosen to earn o 120 minutes) or e each (approx. 30 minutes) or e each (approx. 30 minutes). as method of assessmination of one candidate er must inform student	path and functional i thods of Green's func - if other than Germa an German, examina a bonus) utes) or utes per candidate) o ent, this may be chai e each or an oral exa ts about this by four	ntegrals to quantum tions and Feyman d n) tion offered — if not r nged and assessmer mination in groups. weeks prior to the or	many-partic- iagrams. every seme- every seme- lf the method riginal exami-
Additio	nat inf	ormation				
Worklo	ad					
240 h						
Teachi	ng cycl	е				
Referre	d to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
Master's wi	ith 1 majo	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 125 / 215

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 126 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation
Introduction	to Gauge/Gravity Duality	/		11-GGD-161-m01
Module coor	dinator		Module offered by	
Managing Di and Astrophy	rector of the Institute of T /sics	heoretical Physics	Faculty of Physics a	and Astronomy
ECTS Met	nod of grading	Only after succ. co	mpl. of module(s)	
8 num	erical grade			
Duration	Module level	Other prerequisites	5	
1 semester	graduate			
Contents	·			
 Elements of Quanti Interace Quanti Renorr Gauge Confor Large I Supers Elements of Manifo Rieman Black I Elements of Open a Strings Type II D-Brand The AdS/O Statem Near-h Field-oo Tests of Hologr Extensions Hologr Applicatio Quanti Black I Applicatio Finite of Quanti Hologr Applicatio Guanti Hologr Finite of Quanti Black I Hologr Applicatio Guanti Black I Hologr Finite of Quanti Black I Hologr Applicatio Gravity 	nalisation Group Fields mal Symmetry Vexpansion symmetry of gravity olds, coordinate covariand on curvature ally symmetric spacetime holes of string theory and closed strings of string theory and closed strings in background fields B String Theory es FT correspondence orizon limit of D3-Branes perator correspondence of the correspondence of the correspondence: Co aphic principle s to non-conformal theori aphic renormalisation gro aphic C-Theorem ns I: Thermo- and hydrodru um field theory at finite te	es prelation functions onformal anomaly es pup ynamics emperature malism scosity and conductiv physics her-Nordström black h		

Master's with 1 major Physics (2016)	s (2016)
--------------------------------------	----------

Intended learning outcomes

The students acquire a thorough understanding of the foundations of gauge/gravity duality and the ability to carry out basic tests. Depending on the pre-existing knowledge and interests of the students, the module addresses a selection of the aforementioned topics. Knowledge of quantum mechanics and classical electrodynamics is a prerequisite for this course. Knowledge of quantum field theory and general relativity is useful, but not a prerequisite.

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

V (4) + R (2)

Module taught in: 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)

a) written examination (approx. 90 to 120 minutes) or

- b) oral examination of one candidate each (approx. 30 minutes) or
- c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or

d) project report (approx. 8 to 10 pages) or

e) presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: German and/or English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

--

Additional information

--

Workload

240 h

Teaching cycle

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

--

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 128 / 215
	reg. data record Master (120 ECTS) Physik - 2016	



Master's degree (1 major) Mathematics (2024)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 129 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

	Module title				Abbreviation		
		or Physics			11-HLPH-161-m01		
Module	e coord	inator		Module offered by			
		ector of the Institute of A		Faculty of Physics a	nd Astronomy		
ECTS		od of grading	Only after succ. con	npl. of module(s)			
6		rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
1. Symr 2. Cryst 3. Optic 4. Elect 5. Temp 6. Magr	Contents 1. Symmetry properties 2. Crystal formation and electronic band structure 3. Optical excitations and their coupling effects 4. Electron-phonon coupling 5. Temperature-dependent transport properties 6. Magnetic semiconductors Intended learning outcomes						
		are familiar with the prin	ciples of Semiconduc	tor Physics They up	derstand the structu	re of semi-	
		id know their physical p				le of Seilli-	
		, number of weekly cont					
V (3) + I Module		t in: German or English					
ster, inf a) writte	 Method of assessment (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 to 120 minutes) or 						
c) oral e d) proje e) prese If a writ stead ta of asse nation o Langua Assess	 b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocat	ion of p	olaces					
 Additio	nal inf	ormation					
Worklo	ad						
180 h							
Teachir	ng cycl	e					
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	appea	urs in					
Master' Master'	's degr 's degr	ee (1 major) Mathematic ee (1 major) Physics (20	16)				
		ee (1 major) Nanostructu				· · · · · · · · · · · · · · · · · · ·	
waster's wi	iin 1 majoi	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 130 / 215	

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 131 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Optica	l Prope	rties of Semiconductor	Nanostructures		11-HNS-161-m01	
Module	e coord	inator		Module offered by		
		ector of the Institute of A	oplied Physics	Faculty of Physics and Astronomy		
ECTS		od of grading	Only after succ. cor		, , , , , , , , , , , , , , , , , , ,	
6		rical grade		•		
Duratio	on	Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conten	Its					
or mac ging th tures o with a f of nove	roscop eir size f varyir focus o el optoe	ic crystals, their electror . The lecture addresses og dimensions (2D, 1D, c n optical properties and	nic, optical and magne technological challen D). It provides the ba I light-matter coupling photonic devices bas	etic properties can be ges in the preparations sic theoretical conce g. Moreover, it discuss ed on such nanostru	'. In contrast to atoms, molecules e systematically tailored by chan- on of semiconductor nanostruc- epts to describe their properties, sees the challenges and concepts octures, including building blocks	
		ning outcomes				
The stu knowle	idents edge of	know the theoretical pri	ods to fabricate such	structures, and of the	tor nanostructures. They have eir applications to novel photonic arch.	
Course	s (type	, number of weekly cont	act hours, language -	– if other than Germa	an)	
V (3) + Module		t in: German or English				
		sessment (type, scope, ion on whether module			ation offered — if not every seme-	
 b) oral c) oral d) proje e) pres lf a write stead te of assession Langua 	examir examin ect repo entatio tten exa ake the essmen date at age of a	e form of an oral examin	each (approx. 30 min of 2, approx. 30 minues) or ites). Is method of assessmation of one candidat er must inform studen d/or English	utes per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may in- mination in groups. If the methoo weeks prior to the original exami-	
Allocat	ion of _l	places				
Additio	onal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module	e appea	ars in				
Master	's degr	ee (1 major) Mathematio	cs (2016)			

Master's with 1 major Physics (2016)

Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 133 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title		Abbreviation			
		ld Theory			11-KFT-161-m01	
Module	e coord	inator		Module offered by	Module offered by	
Manag and As		ector of the Institute of sics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conten	ts					
two-dir (Ising, f scale ir variance two dim relevan on, qua edge in particu ons, fo the firs o. Intro point) 1. Confic ctions) 2. Confi tion an on, the 3. Cent sation, weight	1. Conformal theories in D dimensions (conformal group, conformal algebra in 2D, constraints on correlation fun-					
Intende	ed lear	ning outcomes				
comple also ac primari	etion of quire b ly addr ing acq	acquire practical and co "Quantum Mechanics pasic knowledge of criti ressed to students of Th puainted with a sophist s.	ll" (11-QM2) is the only cal phenomena, quant neoretical Physics and	prerequisite to take um field theory and t aims to increase the	part in this course, t functional integrals. ir general level of kn	he students The course is owledge by
Course	s (type	, number of weekly con	tact hours, language -	– if other than Germa	an)	
V (3) + Module		t in: German or English				
	Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)					
b) oral c) oral d) proje e) pres	examir examin ect repo entatio	mination (approx. 90 to nation of one candidate nation in groups (group ort (approx. 8 to 10 pag n/talk (approx. 30 min rPhysics (2016)	e each (approx. 30 min s of 2, approx. 30 minu es) or utes).			page 134 / 215
		,,		cord Master (120 ECTS) Physi		

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: German and/or English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

Additional information

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Workload

180 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 135 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	Module title			Abbreviation		
		d Theory 2			11-KFT2-161-m01	
Module	e coordi	nator		Module offered by		
Managi and Ast		ctor of the Institute of ics	Theoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS		d of grading	Only after succ. con	pl. of module(s)		
6	numer	ical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
 Minimal models (critical statistical mechanics models (Ising, tricritical Ising, 3 state Potts model, restricted solid-on-solid models), correlation functions of the critical Ising model, fusion rules and Verlinde algebra, Land-au-Ginzburg description of minimal models, modified Coulomb gas method and its application to the Ising model, superconformal models) Free bosons and fermions (mode expansions, twist fields, fermionic zero modes and fermion parity) Free fermions on the torus (operator implementation of the partition function, vacuum energies, representations of Virasoro algebra, modular group and fermionic spin structures, Virasoro characters, critical Ising model on the torus, Jacobi theta function identities) Free bosons on the torus (Lagrangian formulation of the partition function, fermionisation, orbifolds in general, S1/Z2 orbifold, Gaussian and Askhin-Teller models, duality between original and orbifold theories, marginal operators, the space of c=1 theories) Intended learning outcomes The students acquire practical and conceptional familiarity with the methods of conformal field theory. As the completion of "Quantum Mechanics II" (11-QM2) is the only prerequisite to take part in this course, the students also acquire basic knowledge of critical phenomena, quantum field theory and functional integrals. The course is primarily addressed to students of Theoretical Physics and aims to increase their general level of knowledge by 						
Matter	Physics	uainted with a sophisti number of weekly con			· · ·	
V (3) +		number of weekly con			11)	
Module	e taught	in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocation of places						
Additional information						
Workload						
180 h						
	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 136 / 215

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 137 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

	Module title				Abbreviation	
Magnet					11-MAG-161-m01	
Module	e coord	inator		Module offered by		
Managi	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS		od of grading	Only after succ. con	pl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
	Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain struc- ture, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo ef- fect.					
Intende	ed lear	ning outcomes				
experin ches ar	nents; nd are a	know basic terms, cond they are skilled in simp able to apply them to ta of these areas; they are	le model building and sks in the stated areas	in the formulation of ; they have compete	mathematical-phys	ical approa-
Course	s (type	, number of weekly con	tact hours, language –	· if other than Germa	n)	
V (3) + I Module		t in: German or English				
Method	d of ass	essment (type, scope, on on whether module			tion offered — if not	every seme-
c) oral e d) proje e) prese If a writ stead ta of asse nation e Langua	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachir		•				
	ig tyti	5				
Referre	d to in	IPOI (examination reg	ulations for teaching.	legree programmes)		
Referred to in LPO I (examination regulations for teaching-degree programmes)						
 Module appears in						
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016)						
Master's degree (1 major) Nanostructure Technology (2016)						
	-	ee (1 major) Computati		6)		
		Physics (2016)		irg • generated 19-Apr-2025 •	exam.	page 138 / 215
			reg. data rec	ord Master (120 ECTS) Physik	x - 2016	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 139 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title Abbreviation					
Master	r Thesis	Physics			11-MA-P-161-m01
Modul	e coord	inator		Module offered by	
		f examination committee		Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con	· · ·	,
30	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	graduate			
Conter	nts				
		vork on an experimental nd according to scientific			s, in particular using state-of-the-
Intend	ed lear	ning outcomes			
		are able to independently own methods and scienti			ask from Physics, especially ac- s in a final paper.
Course	es (type	, number of weekly conta	ct hours, language –	- if other than Germa	ın)
No cou	irses as	signed to module			
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-
		s (750 to 900 hours total ssessment: German and,	-		
Allocat	tion of p	olaces			
Additio	onal inf	ormation			
Time to	o compl	ete: 6 months.			
Worklo	ad				
900 h					
Teachi	ng cycl	e			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Modul	e appea	irs in			
	•	ee (1 major) Physics (201			
Master	r's degr	ee (1 major) Physics (202	o)		

Module	Module title				Abbreviation	
Multi-w	vavelen	gth Astronomy			11-MAS-161-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of ics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
2. Jet-er 3. VLBI 4. High	missior observ -energy	logy of active galactic r n processes ations of jets observations of jets nger signatures of jets	nuclei and extragalactio	c jets		
Intende	ed learn	ning outcomes				
nuclei a	and the	acquire knowledge of m ir extragalactic jets. Th g an observational pro	ey gain insights into a			
Course	s (type,	number of weekly con	tact hours, language —	- if other than Germa	n)	
V (3) + Module		t in: German or English				
Method	d of ass	essment (type, scope,	language — if other tha	an German, examina	tion offered — if not	every seme-
ster, in	formati	on on whether module	can be chosen to earn	a bonus)		
 b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua 	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
		ee (1 major) Mathemati	cs (2016)			
Master	's degre	ee (1 major) Physics (20				
Master's wi	th 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 141 / 215

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 142 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Modul					Abbreviation	
Scientific Methods and Project Management Physics					11-MP-P-161-m01	
Module coordinator				Module offered by		
chairperson of examination committee			ee	Faculty of Physics and Astronomy		
ECTS	1	od of grading	Only after succ. co	· · · ·	•	
15	(not)	successfully completed	L	· · · · ·		
Duratio	on	Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conter	nts					
	tical an				project planning. Application to t plan for the planned Master's	
Intend	ed lear	ning outcomes				
thods o topic o experir	of a cur If the M nental	rrent experimental and laster's thesis. They are or theoretical work. Th	theoretical subdiscipli able to draft a project ey are able to describe	ne of Physics with sp plan for the Master' their projects in oral		
Course	s (type	e, number of weekly co	ntact hours, language -	– if other than Germa	an)	
R (4) Module	e taugł	nt in: German or English	1			
		sessment (type, scope ion on whether module			ation offered — if not every seme	
		ussion (30 to 45 minut assessment: German a				
Allocat	tion of	places				
Additio	onal inf	formation				
Worklo	ad					
450 h			-			
Teachi	ng cvcl	le				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)	
			<u> </u>	<u> </u>		
Modul	e appe	ars in				
		ree (1 major) Physics (2	016)			
	-					
master	Jucsi	ree (1 major) Physics (2	020)			

NRI), has played a major ro	Applied Physics Only after succ. con Other prerequisites 		11-MRI-171-mo1 and Astronomy				
Director of the Institute of ethod of grading umerical grade Module level r graduate agnetic resonance (NMR) i MRI), has played a major ro	Only after succ. con Other prerequisites 	Faculty of Physics a mpl. of module(s)	I Ind Astronomy				
ethod of grading umerical grade Module level r graduate agnetic resonance (NMR) i MRI), has played a major ro	Only after succ. con Other prerequisites 	Faculty of Physics a mpl. of module(s)	nd Astronomy				
ethod of grading umerical grade Module level r graduate agnetic resonance (NMR) i MRI), has played a major ro	Only after succ. con Other prerequisites 	mpl. of module(s)					
umerical grade Module level r graduate agnetic resonance (NMR) i MRI), has played a major ro	 Other prerequisites 			Jucc. compl. of module(s)			
r graduate agnetic resonance (NMR) i MRI), has played a major ro		5					
agnetic resonance (NMR) i MRI), has played a major ro							
NRI), has played a major ro	s a quantum mechanic						
NRI), has played a major ro	s a quantum mechanic						
e covers: R signal theory and signal enciples of spatial encoding, urement parameters, cept of k-space and Fourie sical, methodological and of MRI of biomedical resear	le in the revolution of agnetic resonance (res evolution (Bloch equat magnetic resonance i r imaging, and technical possibilities	medical imaging over sonance principle, rel ions), maging (MRI) and co and limits of MRI. As		the t) ices			
netic resonance, image gen is interdisciplinary contexts	eration and processing and applications.	g. They gain a broad	overview of the field of mode				
	tact hours, language -	– if other than Germa	in)				
-							
			tion offered — if not every se	eme-			
amination of one candidate mination in groups (group report (approx. 8 to 10 pag ation/talk (approx. 30 min n examination was chosen the form of an oral examin ment is changed, the lectur te at the latest. of assessment: German ar	e each (approx. 30 min s of 2, approx. 30 minu es) or utes) as method of assessm nation of one candidat er must inform studen nd/or English	utes per candidate) o nent, this may be chan le each or an oral exa ts about this by four	nged and assessment may ir mination in groups. If the me weeks prior to the original ex	ethod			
of places							
linformation							
cycle							
o in LPO I (examination reg	gulations for teaching-	degree programmes)					
major Physics (2016)				/ 215			
	vsical, methodological and of MRI of biomedical resear learning outcomes ints have advanced knowlenetic resonance, image gen its interdisciplinary contexts type, number of weekly contexts type, number of weekly contexts interdisciplinary contexts fassessment (type, scope, mation on whether module examination (approx. 90 to amination of one candidate amination in groups (groups report (approx. 8 to 10 pag tation/talk (approx. 30 min n examination was chosen the form of an oral examination is changed, the lectur te at the latest. of assessment: German an ent offered: In the semester in of places	of MRI of biomedical research, clinical imaging an learning outcomes Ints have advanced knowledge of the mathematic hetic resonance, image generation and processin its interdisciplinary contexts and applications. Type, number of weekly contact hours, language – 1) hught in: English f assessment (type, scope, language – if other the mation on whether module can be chosen to earn examination (approx. 90 to 120 minutes) or amination in groups (groups of 2, approx. 30 minuters) or amination in groups (groups of 2, approx. 30 minuters) in examination was chosen as method of assessment the form of an oral examination of one candidate ment is changed, the lecturer must inform student te at the latest. of assessment: German and/or English ent offered: In the semester in which the course is n of places l information l information major Physics (2016) JMU Würzt	rsical, methodological and technical possibilities and limits of MRI. As of MRI of biomedical research, clinical imaging and non-destructive test learning outcomes Ints have advanced knowledge of the mathematical-theoretical and phetic resonance, image generation and processing. They gain a broad its interdisciplinary contexts and applications. type, number of weekly contact hours, language — if other than German a) mught in: English f assessment (type, scope, language — if other than German, examination on whether module can be chosen to earn a bonus) examination of one candidate each (approx. 30 minutes) or amination of one candidate each (approx. 30 minutes) or amination in groups (groups of 2, approx. 30 minutes) or amination was chosen as method of assessment, this may be chard to the farm of an oral examination of one candidate each or an oral exa- ment is changed, the lecturer must inform students about this by four te at the latest. of assessment: German and/or English ent offered: In the semester in which the course is offered and in the su- to fplaces L information L information L information L information regulations for teaching-degree programmes)	rsical, methodological and technical possibilities and limits of MRI. As a last point, exemplary appl of MRI of biomedical research, clinical imaging and non-destructive testing are introduced. learning outcomes Ints have advanced knowledge of the mathematical-theoretical and physical principles of modern in hetic resonance, image generation and processing. They gain a broad overview of the field of moders is interdisciplinary contexts and applications. type, number of weekly contact hours, language — if other than German) a) ught in: English f assessment (type, scope, language — if other than German, examination offered — if not every see mation on whether module can be chosen to earn a bonus) examination of one candidate each (approx. 30 minutes) or amination of one candidate each (approx. 30 minutes) or amination of one candidate each (approx. 30 minutes) or tation/talk (approx. 30 to 120 minutes) n examination was chosen as method of assessment, this may be changed and assessment may in e the form of an oral examination of one candidate each or an oral examination in groups. If the me ment is changed, the lecturer must inform students about this by four weeks prior to the original ex- te at the latest. of assessment: German and/or English ent offered: In the semester in which the course is offered and in the subsequent semester n of places l information l information l information i tupO1 (examination regulations for teaching-degree programmes)			

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021)

exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 145 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation		
Magnetism and Spin Fluids					11-MSF-161-m01
Module coordinator				Module offered by	
	Managing Director of the Institute of Theoretical Physics and Astrophysics			Faculty of Physics a	ind Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6		rical grade		• • • •	
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
ladders dered s Possibl 1. Princ Heisen 2. Magu 3. Valer gap) 4. Critic to-Yoko 5. Coup 6. Chira 7. Kitae 8. Kitae Intende	The contents of the course vary from year to year and include topics such as spin-wave theory, spin-chains, spin ladders and spin liquids with topological orders. Depending on the lecturer, the focus may lie on magnetically or- dered systems or on spin liquids. Possible topics are: 1. Principles of magnetism. Ferromagnetic and antiferromagnetic exchange, super-exchange, Hubbard, t-j- and Heisenberg models 2. Magnetic order (Holstein-Primakoff bosons and spin-wave theory) 3. Valence bond solids in spin chains (Majumdar-Gosh and AKLT Models, spinon confinement and the Haldane				
mensio	ns.				with a topological order in two di-
		, number of weekly conta	ict nours, language –	- If other than Germa	in) I
V (3) + Module		t in: German or English			
		sessment (type, scope, la on on whether module ca			tion offered — if not every seme-
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places					
Additio	nal inf	ormation			

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.
	reg. data record Master (120 ECTS) Physik - 2016

Workload

180 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 147 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation		
Low Dimensional Structures 11-NDS-161-mo1						
Module coordinator			Module offered by			
Managing Director of the Institute of Applied Physics		nnlied Physics		nd Astronomy		
	od of grading		ics Faculty of Physics and Astronomy succ. compl. of module(s)			
	rical grade					
Duration	Module level	Other prerequisites				
1 semester	graduate		ination committee r	equired.		
Contents	•					
	nal structures: Crystal la . Comparison between tł					
Intended lear	ning outcomes					
semiconducto odes. They are evaluate the i dimension by band structure familiar with t free electron g tor and Landa and are able t two-dimensio Courses (type V (3) + R (1) Method of ass ster, informat a) written exa b) oral examin c) oral examin d) project rep e) presentatio If a written exa stead take the	, number of weekly conta sessment (type, scope, la ion on whether module of mination (approx. 90 to nation of one candidate of nation in groups (groups ort (approx. 8 to 10 page on/talk (approx. 30 minut amination was chosen as e form of an oral examina- t is changed, the lecture	tion and characteristic nd structure of semic cle effects. They are a ation. They know the k ucture. They have kno ney understand how a ic knowledge of the m erstand the depender s via numerical metho act hours, language – anguage — if other the an be chosen to earn 120 minutes) or each (approx. 30 minu of 2, approx. 30 minu s) or tes) s method of assessmention of one candidate	cs of semiconductor onductor heterostruc- able to solve problem (*p perturbation theo- wledge of the meani- an external magnetic beaning of gauging, L ice of various physic ods. They are familia - if other than Germa an German, examina a bonus) utes) or tes per candidate) o ent, this may be chan- e each or an oral exa	heterostructures an ctures and MOS-dio is related to potenti ory and can deduce ng of modulation do field acts on the pro- andau-quantisatior al properties on the r with elementary ex n) tion offered — if not	d MOS-di- des and can als in one the 2D sub- oping and are operties of a a, filling fac- filling factor, filling factor, filli	
Language of a	ssessment: German and	/or English				
Allocation of	places					
Additional inf	ormation					
Workload						
180 h						
Teaching cycle						
Referred to in	LPOI (examination regu	ulations for teaching-o	degree programmes)			
Master's with 1 majo	r Physics (2016)		urg • generated 19-Apr-2025		page 148 / 215	
		reg. data rec	cord Master (120 ECTS) Physil	(- 2016		

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 149 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation	
Computational Astrophysics			11-NMA-161-m01			
Module coordinator		Module offered by				
Managi and Ast	-	ector of the Institute of T sics	heoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS		od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
rithms Lattice-	(tree- a Boltzm	ods used in astrophysica nd polynomial codes). P nann). Hyperbolic conser s of high-performance co	article-mesh method vation laws (fluid dyn	s (particle-in-cell me amics, finite differer	thods). Vlasow meth nce method, Rieman	iods (e.g., n solver,
Intende	ed lear	ning outcomes				
sics wit	h the h	are able to solve typical nelp of numerical simula roblems and of validatir	tions. They are espec			
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (3) + I Module		t in: German or English				
Method	d of ass	sessment (type, scope, la on on whether module of			tion offered — if not	every seme-
 b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua 	a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester					
Allocal		Jiaces	_			
Adaitio	nat inf	ormation				
Workload						
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master	's degr	ee (1 major) Physics (201 ee (1 major) Mathematic				
Master's wi	th 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 150 / 215

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 151 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Nano-C	Nano-Optics 11-NOP-161-mo1					
Module coordinator				Module offered by		
Manag	ing Dire	ector of the Institute of A	of Applied Physics Faculty of Physics and Astronomy			
ECTS	·	od of grading	Only after succ. compl. of module(s)			
6	·	rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
The lec from th copy at basis, 2D, 1D tennas	ture co ne discu re discu quantu and o c	nveys theoretical funda ission of the focusing o issed. In the following, m emitters are introduc limensions are introduc	f light. Based on this, t the near-field optical r ed and their light emis	the fundamentals of nicroscopy is introdu ssion in nano-enviror	modern far-field opt iced and discussed. iments is derived. Pl	ical micros- As a further asmons in
	-	ning outcomes				
		nave specific and advar les and application area	•	•		th the theo-
Course	s (type	, number of weekly cont	act hours, language –	- if other than Germa	n)	
V (3) + Module		t in: German or English				
Metho	d of ass	essment (type, scope,			tion offered — if not	every seme-
a) writt b) oral c) oral d) proj e) pres lf a wri stead t of asse nation Langua	ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester					
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master	Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
		ning degree Gymnasium Physics (2016)		urg • generated 19-Apr-2025 •		016) page 152 / 215
musici S W	ini i majol	- nysics (2010)		cord Master (120 ECTS) Physil		puge 152 / 215

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Quantum Technology (2021)

exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 153 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Organic Semiconductors			11-OHL-161-m01			
Module coordinator Module offered by						
Managing Director of the Institute of Applied Physics			nuliad Dhusias	Faculty of Physics and Astronomy		
	<u> </u>				ind Astronomy	
ECTS	<u> </u>	od of grading	Only after succ. con	ipl. of module(s)		
6	·	rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conter		<u> </u>		1 1 1 1		
	nentals	of organic semiconduct	tors, molecular and po	olymer electronics ar	id sensor technology	i, applicati-
ons.		aing outcomos				
		ning outcomes		· ·		
		nave advanced knowled				
		, number of weekly cont	act hours, language –	- if other than Germa	n)	
V (3) + Modul		t in: German or English				
		essment (type, scope, l	anguage — if other th	an German, examina	tion offered — if not	everv seme-
		on on whether module of				
		mination (approx. 90 to				
		ation of one candidate				
		ation in groups (groups		tes per candidate) o	r	
		ort (approx. 8 to 10 page n/talk (approx. 30 minu				
		amination was chosen a		ent, this may be chai	nged and assessmen	nt may in-
		form of an oral examination				
		t is changed, the lecture				
		the latest.				
		ssessment: German and		сс I I. ч		
		ffered: In the semester i	n which the course is	offered and in the st	ibsequent semester	
Allocat	tion of p	olaces				
Additio	onal inf	ormation	_			
			_			
Worklo	oad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module appears in						
Master's degree (1 major) Physics (2016)						
Master's degree (1 major) Nanostructure Technology (2016)						
Master's degree (1 major) Functional Materials (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Nanostructure Technology (2020)						
	Master's degree (1 major) Physics (2020)					
		ning degree Gymnasium				
Master's w	nth 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 154 / 215

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Functional Materials (2022) exchange program Physics (2023) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 155 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation
Open Quantum Systems					11-0QS-242-m01
Module coordinator				Module offered by	
Managir	ng Dire	ector of the Institute of Th	eoretical Physics	Faculty of Physics a	and Astronomy
and Asti			,		,
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	numer	rical grade			
Duration	1 (Module level	Other prerequisites		
1 semes	ter	graduate			
Content	s				
density cesses	matrix	theory, stochastic proce	sses in Hilbert space	e, non-Markovian pro	ocesses, relativistic quantum pro-
Intende	d learr	ning outcomes			
		of a theoretical understar	nding of quantum sv	stem coupled to thei	r environment
		, number of weekly conta			
V(3) + R		muniper of weekly collia	et nours, language –		
	• •	t in: German or English			
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-
of asses nation d Languag	sment ate at ge of a nent of	t is changed, the lecturer the latest. ssessment: German and, ffered: In the semester in	must inform student [/] or English	s about this by four	mination in groups. If the method weeks prior to the original exami- ubsequent semester
	•				
Addition	nal info	ormation			
Workloa	d				
	u				
180 h					
Teachin	g cycle	9			
 Poforroc	l to in	LPO I (examination regu	lations for toaching	degree programmes)	
Module	appea	rs in			
		ee (1 major) Physics (2010	6)		
		ee (1 major) Mathematica			
	-	ee (1 major) Physics (202	-		
	-	ee (1 major) Mathematica	-		
Master's	s degre	ee (1 major) Mathematica	l Physics (2022)		
exchang	ge prog	gram Physics (2023)			

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 156 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Modul					Abbreviation
Advan	ced Ser	ninar Physics A			11-OSP-A-161-m01
Module coordinator				Module offered by	
		ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. cor		,
5		rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Admission prerequi 85% of sessions).	site to assessment:	regular attendance (minimum
Conter	Its				
Semina	ar on cu	irrent topics in theoretica	ll and experimental p	hysics	
Intend	ed lear	ning outcomes			
are abl	e to ext				ental or Theoretical Physics. They this knowledge and present it to
Course	s (type	, number of weekly conta	ict hours, language –	- if other than Germa	an)
S (2)					
		t in: German or English			
		sessment (type, scope, la ion on whether module c			ition offered — if not every seme-
		ussion (30 to 45 minutes) ssessment: German and			
Allocat	ion of _l	olaces			
Additio	onal inf	ormation			
this wi 3 Sente find the gistrati ly regis sessme	II be co ence 47 at the s ion for a ster for a ent was	nsidered a declaration of ASPO (general academic tudent has obtained the assessment into effect. O an assessment. Students not put into effect will n	will to seek admissi and examination reg qualification for adm nly those students th who did not register ot be admitted to the	on to assessment pu ulations). If the mod lission to assessmer nat meet the respect for an assessment of respective assessment	for admission to assessment, ursuant to Section 20 Subsection ule coordinators subsequently nt, they will put the student's re- ive prerequisites can successful- or whose registration for an as- tent. If a student takes an as- assessment will not be considered
Worklo	ad				
150 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Modul	e appea	ars in			
		ee (1 major) Physics (201	6)		
Master	's degr	ee (1 major) Physics (202			
exchar	ige prog	gram Physics (2023)			

Modul	e title				Abbreviation
Advand	ced Ser	ninar Physics B			11-OSP-B-161-m01
Modul	e coord	inator		Module offered by	
		ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con		•
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	graduate	Admission prerequi 85% of sessions).	site to assessment:	regular attendance (minimum
Conter	nts				
Semina	ar on cu	irrent issues of Theoretic	al or Experimental Ph	ysics.	
Intend	ed lear	ning outcomes			
are abl	e to ext				ntal or Theoretical Physics. They this knowledge and present it to
Course	s (type	, number of weekly conta	ict hours, language –	- if other than Germa	in)
S (2)					
		t in: German or English			
		sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
		ussion (30 to 45 minutes) ssessment: German and			
Allocat	tion of j	olaces			
Additio	onal inf	ormation			
this wi 3 Sente find the gistrati ly regis sessme	ll be co ence 47 at the s ion for a ster for a ent was	nsidered a declaration of ASPO (general academic tudent has obtained the assessment into effect. O an assessment. Students not put into effect will n	f will to seek admission and examination reg qualification for adm only those students the who did not register ot be admitted to the	on to assessment pu ulations). If the mod ission to assessmer nat meet the respect for an assessment o respective assessm	for admission to assessment, ursuant to Section 20 Subsection ule coordinators subsequently nt, they will put the student's re- ive prerequisites can successful- or whose registration for an as- tent. If a student takes an as- ssessment will not be considered
Worklo	ad		-		
150 h					
Teachi	ng cycl	е			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
 Modul		are in			
	e appea				
Master	c noor		\sim		
	-	ee (1 major) Physics (201 ee (1 major) Physics (202			

Module	e title				Abbreviation
Advanc	ed Lab	oratory Course Master P	art 1		11-P-FM1-161-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Applied Physics			anlied Dhusies		and Astronomy
ECTS	<u> </u>	od of grading	Only after succ. com	Faculty of Physics a	
3		successfully completed			
Duratio		Module level	Other prerequisites		
1 seme		graduate	Preparation and safe	ety briefing.	
Conten		0			
stems, tic reso	proper nance	ties of solids, surfaces a	nd interfaces. Experin ect - optical pumping	nents on the following	temperatures and correlated sy- ng topics: X-rays - nuclear magne- n the field of optics - Hall effect -
Intende	ed lear	ning outcomes			
suing s experin experin	cientif nental nent ar	c publications, application	on of modern evaluat o work on a task on tl s their results in a scie	ion systems. The stu ne basis of publicati entific publication.	al results, basic knowledge of is- udents are familiar with modern ons, to conduct and evaluate an
	s (type	, number of weekly conta	ict nours, language –	If other than Germa	in)
P (3)					
		sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
fic publ success regulat	licatior sfully c ions ar	n) an experiment to be co	nsidered to have suc s to be considered to tive module descript	cessfully completed have successfully co	aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Allocat	ion of	olaces			
	-				
Additio	onal inf	ormation			
Worklo	ad				
90 h					
Teachir	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
Module	appea	ars in			
Master Master Master Master	's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructur ee (1 major) Nanostructur ee (1 major) Physics (202 ee (1 major) Quantum Teo gram Physics (2023)	re Technology (2016) re Technology (2020) 0)		

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 159 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation
Advanc	ed Lab	ooratory Course Master P	art 2		11-P-FM2-161-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Applied Physics					
Managi ECTS	<u> </u>		, <u>, , , , , , , , , , , , , , , , , , </u>	Faculty of Physics a	and Astronomy
3		od of grading successfully completed	Only after succ. con		
1 seme		graduate	Other prerequisites Preparation and saf	oty briefing	
Conten		giaudate	Freparation and Sar	ety blieling.	
Princip stems, tic reso	les of N proper mance	ties of solids, surfaces a	nd interfaces. Experir ect - optical pumping	nents on the following	temperatures and correlated sy- ng topics: X-rays - nuclear magne n the field of optics - Hall effect -
Intende	ed lear	ning outcomes			
suing s experin experin	cientif nental nent ar	ic publications, application	on of modern evaluat o work on a task on t s their results in a sci	ion systems. The stu ne basis of publicati entific publication.	al results, basic knowledge of is- udents are familiar with modern ions, to conduct and evaluate an
P (3)	s (type		ict nouis, language –		aii)
ster, ini practica Studen fic publ success regulat	format al exan ts mus licatior sfully c ions ar	ion on whether module contraction nination of successfully prepare, p n) an experiment to be co	an be chosen to earn erform, document (la nsidered to have suc s to be considered to tive module descript	a bonus) b notebook) and eva cessfully completed have successfully c	ation offered — if not every seme- aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Allocat	ion of	places			
Additio	nal inf	ormation			
Worklo	ad				
90 h					
Teachi	ng cvcl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-	legree programmes)	
			3	<u> </u>	
Module	e appea	ars in			
Master Master Master Master Master	's degr 's degr 's degr 's degr 's degr	ee (1 major) Physics (201 ee (1 major) Nanostructu ee (1 major) Nanostructu ee (1 major) Physics (202 ee (1 major) Quantum Teo gram Physics (2023)	re Technology (2016) re Technology (2020) 0)		

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.
	reg. data record Master (120 ECTS) Physik - 2016

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Module	e title				Abbreviation
Advanc	ed Lab	ooratory Course Master P	art 3		11-P-FM3-161-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Applied Physics			onlied Physics	Faculty of Physics a	and Astronomy
		od of grading	Only after succ. con	· · ·	
3		successfully completed			
Duratio		Module level	Other prerequisites		
1 seme		graduate	Preparation and saf		
Conten		3.44440			
stems, tic reso	prope nance	rties of solids, surfaces a	nd interfaces. Experir ect - optical pumping	nents on the following	temperatures and correlated sy- ng topics: X-rays - nuclear magne n the field of optics - Hall effect -
Intende	ed lear	ning outcomes			
suing s experir experir	cientif nental nent a	ic publications, applications, applications, applications, methods. They are able to the present and discussed and the present and discussed and the present and discussed approximately appr	on of modern evaluat o work on a task on t s their results in a sci	ion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- udents are familiar with modern ons, to conduct and evaluate an
	s (type	, number of weekly conta	ict nours, language –	- If other than Germa	in)
Р (3)					
ster, in	format	ion on whether module c nination			tion offered — if not every seme-
Studen fic pub succes regulat	its mus licatioi sfully c ions ai	st successfully prepare, p n) an experiment to be co	nsidered to have suc s to be considered to ctive module descript	cessfully completed have successfully co	aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Allocat	ion of	places			
Additio	onal inf	ormation			
Worklo	ad				
90 h					
Teachi		e			
	3				
Referre	d to in	LPO I (examination regu	lations for teaching.	legree programmes)	
Module	anne	ars in			
Master Master Master Master	's degr 's degr 's degr 's degr	ree (1 major) Physics (201 ree (1 major) Nanostructu ree (1 major) Nanostructu ree (1 major) Physics (202	re Technology (2016) re Technology (2020) :0)		
	-	ree (1 major) Quantum Teo gram Physics (2022)	unnology (2021)		
exchan	ige pro	gram Physics (2023)			

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.
	reg. data record Master (120 ECTS) Physik - 2016

Module					Abbreviation
Advanc	ed Lab	ooratory Course Master P	art 4		11-P-FM4-161-m01
Module coordinator				Module offered by	
Manag	ing Dir	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con		,
3		successfully completed			
Duratio		Module level	Other prerequisites		
1 seme		graduate	Preparation and saf		
Conten		0			
stems, tic reso	prope nance	rties of solids, surfaces a	nd interfaces. Experir ect - optical pumping	nents on the following	temperatures and correlated sy- ng topics: X-rays - nuclear magne n the field of optics - Hall effect -
	-	ning outcomes			
suing s experir experir	cientif nental nent a	ic publications, applications, applications, applications, methods. They are able to have a series and to present and discusses and the present and discusses approximately a	on of modern evaluat o work on a task on t s their results in a sci	tion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- udents are familiar with modern ions, to conduct and evaluate an
	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	an)
P (3)					
		sessment (type, scope, la ion on whether module c			ation offered — if not every seme-
fic pub succes regulat	lication sfully o ions an	n) an experiment to be co	nsidered to have suc s to be considered to tive module descript	cessfully completed have successfully c	aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Allocat	ion of	places			
Additio	onal inf	ormation			
Worklo	ad				
90 h					
Teachi	ng cycl	e			
			-		
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Module	e appe	ars in			
Master Master Master	's degr 's degr 's degr	ree (1 major) Physics (201 ree (1 major) Nanostructur ree (1 major) Nanostructur ree (1 major) Physics (202	re Technology (2016) re Technology (2020) 0)		
Master	's degr	ee (1 major) Quantum Teo	chnology (2021)		
		gram Physics (2023)	•,		

Master's with 1 major Physics (2016)	
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Module title					Abbreviation	
Physic	s of Co	mplex Systems		11-PKS-161-m01		
Modul	e coord	inator		Module offered by		
	Managing Director of the Institute of Theoretical Physics and Astrophysics			Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conter	ts					
2. Intro 3. Entro 4. Phas 5. Univ 6. Spin	oduction opy pro se trans ersality glasse		f equilibriumt ist			
		ning outcomes				
The stu derstar unders	idents nding o tanding	acquire in-depth knowl f cooperative phenome g of the concepts of ent es in different areas of	na in complex many-p ropy, entropy producti	article systems. The on and universality.	main focus includes	a thorough
Course	s (type	, number of weekly con	tact hours, language –	– if other than Germa	ın)	
V (2) + Module		t in: German or English				
		sessment (type, scope, ion on whether module			ition offered — if not	every seme-
b) oral c) oral d) proj e) pres If a wri stead t of asse nation Langua	ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester					
Allocat	ion of _l	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination reg	gulations for teaching-	degree programmes)		
			0			
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Master's w	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physil		page 163 / 215

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 164 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Physics	e title			Abbreviation				
	s of Advanced Materials			11-PMM-161-m01				
Madula	coordinator		Modulo offered by	<u> </u>				
	· · · · · · · · · · · · · · · · · · ·	muliad Dhusiaa	Module offered by Faculty of Physics and Astronomy					
	ng Director of the Institute of A	<u>'</u>		ind Astronomy				
ECTS 6	Method of grading numerical grade	Only after succ. co	mpl. of module(s)					
Duratio		Other prerequisites	S					
1 semes								
Content		_						
and sup	l properties of various materia perconductors; thin films, hete ; two-dimensional layer materi	rostructures and sup						
Intende	ed learning outcomes							
	dents know the properties and	 I characterization met	thods of some moder	n materials.				
	s (type, number of weekly cont							
		act nours, tallguage -	n other than Gerilla	11 <i>1)</i>				
V (3) + F Module	R (1) e taught in: German or English							
	d of assessment (type, scope, l	if other th	an Corman, oxamina	tion offered — if no	t ovory somo-			
	formation on whether module				t every seme-			
	en examination (approx. 90 to		,					
	examination of one candidate		utes) or					
				r				
d) proje	ect report (approx. 8 to 10 page	c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx, 8 to 10 pages) or						
e) presentation/talk (approx. 30 minutes).								
		tes).						
lf a writ	ten examination was chosen a	tes). s method of assessm						
If a write stead ta	ten examination was chosen a ake the form of an oral examin	tes). s method of assessm ation of one candidat	e each or an oral exa	mination in groups.	. If the method			
If a write stead ta of asses	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture	tes). s method of assessm ation of one candidat	e each or an oral exa	mination in groups.	. If the method			
If a writh stead ta of asses nation o	ten examination was chosen a ake the form of an oral examin	tes). s method of assessm ation of one candidat er must inform studen	e each or an oral exa	mination in groups.	. If the method			
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If a writt stead ta of asses nation o Languag Assess Allocati	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester ion of places	ites). s method of assessm ation of one candidat er must inform studen d/or English	e each or an oral exa ts about this by four	mination in groups. weeks prior to the o	. If the method original exami-			
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If a writt stead ta of asses nation of Languag Assess Allocati Addition Workloa	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information	ites). s method of assessm ation of one candidat er must inform studen d/or English	e each or an oral exa ts about this by four	mination in groups. weeks prior to the o	. If the method original exami-			
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If a writt stead ta of asses nation of Languag Assess Allocati Addition Workloa	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad	ites). s method of assessm ation of one candidat er must inform studen d/or English	e each or an oral exa ts about this by four	mination in groups. weeks prior to the o	. If the method original exami-			
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If a writt stead ta of asses nation of Languag Assessin Allocati Workloa 180 h Teachin Referren	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is	e each or an oral example each or an oral example is about this by four the subsection of the subsecti	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami-			
If a writt stead ta of asses nation of Languag Assess Allocati Addition Workloa 180 h Teachin Referre Module	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad ng cycle d to in LPO I (examination reg	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching-	e each or an oral example each or an oral example is about this by four the subsection of the subsecti	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami-			
If a writt stead ta of asses nation of Languag Assessin Allocati Workloa 180 h Teachin Referree Module Master'	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad ad ad ad appears in	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- is (2016)	e each or an oral example each or an oral example is about this by four the subsection of the subsecti	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami-			
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If a writt stead ta of asses nation of Languag Assessin Allocati Workloa 180 h Teachin Referren Master' Master' Master' Master'	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad ad ad ad ad ad ad ad ad ad ad ad ad	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- is (2016) 16) ure Technology (2016) nal Mathematics (201	e each or an oral exa- its about this by four the subsection of the	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami			
If a writt stead ta of asses nation of Languag Assessin Allocati Workloa 180 h Teachin Referree Master' Master' Master' Master' Master'	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places mal information ad ad ad ad ad ad ad ad ad ad ad ad ad	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- is (2016) 16) ure Technology (2016) nal Mathematics (2016)	e each or an oral examises about this by four the subsection of th	mination in groups. weeks prior to the o	. If the method original exami- r			
If a writt stead ta of asses nation of Languag Assessif Allocati Workloa 180 h Teachin Referren Master' Master' Master' Master' Master' Master' Master'	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad ad ad ad bg cycle d to in LPO I (examination reg e appears in bs degree (1 major) Mathematio bs degree (1 major) Nanostructure bs degree (1 major) Nanostructure bs degree (1 major) Functional I bs degree (1 major) Functional I	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- is (2016) 16) ure Technology (2016) nal Mathematics (2016) MINT Teacher Educa	e each or an oral examises about this by four this by four this by four this offered and in the subsection of the subsec	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami- r			
If a writt stead ta of asses nation of Languas Assessif Allocati Workloa 180 h Teachin Referree Master' Master' Master' Master' Master' Master' Suppler	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places mal information ad ad ad ad ad ad ad ad ad ad ad ad ad	Ites). Is method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- Is (2016) 16) ure Technology (2016) nal Mathematics (2016) MINT Teacher Educa Education PLUS, Elite	e each or an oral examises about this by four this by four this by four this offered and in the subsection of the subsec	mination in groups. weeks prior to the o ubsequent semeste	. If the method original exami- r			
If a writi stead ta of asses nation o Languas Assessi Allocati Morkloa 180 h Teachin Referre Master' Master' Master' Master' Master' Master' Master'	ten examination was chosen a ake the form of an oral examin ssment is changed, the lecture date at the latest. ge of assessment: German and ment offered: In the semester i ion of places nal information ad ad ad ad bg cycle d to in LPO I (examination reg e appears in bs degree (1 major) Mathematio bs degree (1 major) Nanostructure bs degree (1 major) Nanostructure bs degree (1 major) Functional I bs degree (1 major) Functional I	ites). s method of assessm ation of one candidat er must inform studen d/or English in which the course is ulations for teaching- is (2016) 16) ure Technology (2016) nal Mathematics (2016) MINT Teacher Educa	e each or an oral examises about this by four this by four this by four this offered and in the subsection of the subsec	mination in groups. weeks prior to the o ubsequent semeste	. If the metho priginal exam r			

UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 166 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

	Module title Abbreviation					
Quantu	ım Fielo	d Theory II			11-QFT2-161-m01	
Module	e coord	inator		Module offered by		
Manag and As		ector of the Institute of sics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
8	nume	rical grade				
Duratio		Module level	Other prerequisites	6		
1 seme	ster	graduate				
Conten	ts					
2. Path 3. Renc 4. Renc 5. Gaug 6. Spor	Integra ormaliz ormaliz ge theo ntaneo	ation ation group				
-		ning outcomes				
The stu red the	dents princi	have advanced knowle bles, especially of reno ntum field theory by usi	rmalisation and gauge	theories. They are al		
Course	s (type	, number of weekly con	tact hours, language -	– if other than Germa	ın)	
V (4) + Module		t in: German or English				
		sessment (type, scope,			tion offered — if not	every seme-
 b) oral c) oral d) projetion e) pressification stead t of asset nation Languation 	ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester					If the method riginal exami-
Allocat	ion of _l	olaces				
Additio	onal inf	ormation				
Worklo	Workload					
240 h						
Teachi	ng cvcl	e				
Referre	d to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
Module	e appea	urs in				
Master's w	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 167 / 215

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Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title					Abbreviation	
Quantu	um Info	rmation and Quantum C	omputing		11-QIC-161-m01	
Module	e coord	inator		Module offered by		
		ector of the Institute of T	heoretical Physics	-	nd Astronomy	
	trophys		neoretteat i nysies	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade	11-QM2 or 11-TFK			
Duratio	on	Module level	Other prerequisites	i		
1 seme	ester	graduate				
Conten	nts		_			
2. Qua 3. Com 4. Enta 5. Qua 6. Qua	ntum th posite ingleme ntum o ntum g	ary of classical informati neory seen from the pers systems and the Schmic ent measures perations, POVMs, and t ates and quantum comp f the theory of decoheren	pective of information It decomposition he theorems of Kraus uters			
Intend	ed lear	ning outcomes				
textboo main to	ok inter opics o	acquire a comprehensive pretation. The learn how f the lecture include bas puting arising from decc	to safely handle tens ic mathematical conc	sor products and mu	ltipartite quantum s	ystems. The
Course	s (type	, number of weekly cont	act hours, language –	- if other than Germa	n)	
V (3) + Module		t in: German or English				
		sessment (type, scope, l ion on whether module o			tion offered — if not	every seme-
b) oral c) oral d) proju e) pres If a writ stead t of asse nation Langua	examir examin ect repo- tentatio tten exa ake the essmen date at age of a	mination (approx. 90 to nation of one candidate nation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a form of an oral examina t is changed, the lecture the latest. ssessment: German and ffered: In the semester i	each (approx. 30 minu of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform student l/or English	tes per candidate) of ent, this may be char e each or an oral exa is about this by four	nged and assessme mination in groups. weeks prior to the o	If the method riginal exami-
Allocat	tion of _l	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
			3			
L						
Master's w	vith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 169 / 215

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	pag
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation	
-	Quantum Mechanics II 11-QM2-161-m01 Module coordinator Module offered by				
Module	Module coordinator N				
Managi and Ast	-	ector of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
8	numei	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	undergraduate			
Conten	ts	-			
course for QM: 1. Histo 2. Singl 3. Princ 4. Spin 5. Appre 6. Appre 7. Seco 8. Poter 9. Gene 10. Can 11. Char 12. Qua 13. Qua	"Quant rical in e-parti iples o and an oximat oximat oximat ratial sca onical rged pa ntum t	of this lecture build upon cum Mechanics I". Topics troduction cle states in a central por f quantum mechanics gular momentum ions of energy eigenvalue ions for time-dependent ntisation attering ttering theory formalism articles in electromagneti heory of radiation entanglement hing outcomes	might include: tential es problems	n accordance with th	e topics of the Bachelor's degree
The stu most of	dents a the th	acquire in-depth knowled	courses in Astrophy		s knowledge is highly relevant to and Condensed Matter Physics.
		, number of weekly conta		- if other than Germa	n)
V (4) + I	R (2)	t in: German or English			
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocati	ion of p	olaces			
Additio	nal info	ormation			

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Workload

240 h

Teaching cycle

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

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Quantum Technology (2021)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 172 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title					Abbreviation	
-	Quantum Transport 11-QTH-161-mo1					
Module	e coord	inator		Module offered by		
Managi	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics and Astronomy		
ECTS		od of grading	Only after succ. con	pl. of module(s)		
6	L	rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Contents						
The lecture addresses the fundamental transport phenomena of electrons in nanostructures. This includes the topics of: ballistic and diffuse transport, electron interference effects, quantisation of conductivity, interaction						
phenomena between electrons, Coulomb blockade, thermoelectric properties, description of spin-dependent transport phenomena, topological insulators, solid-state quantum computers.						
			ulators, solid-state qu	iantum computers.		
		ning outcomes				
		nave mastered the basic cations of respective cor		nostructures in theor	y and practice. They	know functi-
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	n)	
V (3) + Module		t in: German or English				
Method	d of ass	essment (type, scope, la	anguage — if other th	an German, examina	tion offered — if not	every seme-
		on on whether module c				
c) oral o d) proje e) prese If a writ stead ta of asse nation Langua	 b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					If the method
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h			-			
Teachi	ng cycl	9				
Referre	d to in	LPOI (examination regu	ulations for teaching-o	degree programmes)		
Module	e appea	irs in				
Master	's degr	ee (1 major) Mathematic	s (2016)			
Master	's degr	ee (1 major) Physics (201	.6)			
	-	ee (1 major) Nanostructu				
	-	ee (1 major) Computation		6)		
		ee (1 major) Functional M				
waster's wi	п 1 тајој	Physics (2016)		irg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 173 / 215

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Functional Materials (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 174 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title		Abbreviation			
Quantum Information Technology			11-QUI-161-m01		
Module coordinator			Module offered by		
Managing Dir	rector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS Meth	od of grading	Only after succ. con	npl. of module(s)		
6 nume	erical grade				
Duration	Module level	Other prerequisites			
1 semester	graduate				
Contents					
proaches tow	ts of quantum mechani vards quantum computi 1 noise, quantum inform	ng (on the basis of pho	tons, ions and nucle		
Intended lea	rning outcomes				
	are familiar with the ba nental approaches for tl	•	•		
Courses (type	e, number of weekly cor	itact hours, language –	- if other than Germa	n)	
V (3) + R (1) Module taugl	nt in: German or English				
Method of as	sessment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
ster, informa	tion on whether module	can be chosen to earn	a bonus)		-
 b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocation of	places				
Additional in	formation				
Workload					
180 h					
Teaching cyc	le	<u> </u>			
		'			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Referred to in Er o'r (examination regulations for teaching-degree programmes)					
Module appears in					
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016)					
Master's degree (1 major) Nanostructure Technology (2016)					
Master's degree (1 major) Computational Mathematics (2016)					
-	ching degree Gymnasiur			ork Bavaria (ENB) (20	016)
Master's with 1 maj		JMU Würzb	urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik	exam.	page 175 / 215
		ieg. udid le		2010	



Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 176 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation		
Many Body Quantum Theory			11-QVTP-161-m01		
Module coordinator			Module offered by	<u> </u>	
Managing Director of the Institute of Theo and Astrophysics		heoretical Physics	Faculty of Physics a	nd Astronomy	
	ethod of grading	Only after succ. con	npl. of module(s)		
8 nu	merical grade				
Duration	Module level	Other prerequisites			
1 semeste	r graduate				
Contents		_			
thods of th 1. Single-p 2. Review 3. Perturba 4. Perturba 5. Landau 6. Superco	 In this lecture, Quantum Physics of many-particle systems are introduced on the basis of the perturbative methods of the Green's functions. A possible outline might be: 1. Single-particle Green's function 2. Review of second quantisation 3. Perturbation theory using many-particle Green's functions at temperature T=0 4. Perturbation theory for finite temperatures 5. Landau theory of Fermi liquids 6. Superconductivity 				
	nensional systems and bos	omsation			
The studer ledge enal and to und Courses (t V (4) + R (2	Intended learning outcomes The students acquire knowledge of the methods of quantum field theory in a non-relativistic context. This know-ledge enables them to study properties of Fermi liquids (and bosonic systems) beyond the one-particle picture, and to understand the effects of interactions, including superconductivity and the Kondo effect. Courses (type, number of weekly contact hours, language — if other than German)				
Module ta	ught in: German or English				
	assessment (type, scope, l nation on whether module			tion offered — if not	every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocation of places					
Additional information					
Workload					
240 h					
Teaching cycle					
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Master's with 1	major Physics (2016)	JMU Würzbı	Irg • generated 19-Apr-2025 •	• exam.	page 177 / 215
			cord Master (120 ECTS) Physil		

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 178 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Renormalization Group Methods in Field Theory			11-RMFT-161-m01			
Module coordinator		Module offered by				
Managing Director of the Institute of Theoretical Physics and Astrophysics		Theoretical Physics	Faculty of Physics a	and Astronomy		
ECTS		od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio		Module level	Other prerequisites	5		
1 seme		graduate				
Conten	ts					
"Renor equatio fermior 1. Wilso 2. Path 3. Beth 4. RG fl	This course is complementary to the discussion of Wilson's renormalisation group (RG) as covered in the course "Renormalisation Group and Critical Phenomena" (11-CRP). It focuses on the diagrammatic formulation of RG flow equations and its relation to diagrammatic perturbation expansions. This is of particular relevance for interacting fermion systems in the context of functional renormalisation groups. An outline of the course might be: 1. Wilson's RG 2. Path integrals of interacting fermions 3. Bethe-Salpeter equation 4. RG flow equations for the one-particle and two-particle vertex				on of RG flow or interacting	
mation)		-	nation selfemes (suc		
6. RG fl	ow equ	ations for spin system	S			
Intende	ed lear	ning outcomes				
ledge s	erves a	become familiar with th is a theoretical basis fo vaves, and nematic ins	or the examination of p			
Course	s (type	, number of weekly cor	tact hours, language –	- if other than Germa	ın)	
V (4) +	R (2)					
Module	e taugh	t in: German or English				
	Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)					
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocation of places						
Additional information						
Workload						
240 h						
Teaching cycle						
Master's wi	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 179 / 215

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

Module appears in

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 180 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation		
Relativistic Quantum Field Theory					11-RQFT-161-m01
Module	coord	inator		Module offered by	
Managing Director of the Institute of Theoretical I and Astrophysics			eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
8	numei	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten					
3. Lagra 4. Field 5. Scatt 6. Gaug 7. Pertu 8. Feyni 9. Quar 10. Rad 11. Rend Intende The stu They kn process standin	ivistic ange fo quanti ering tl ge princ rbatior man ru futum el iative cormalis ed learr dents h ow how ses in t g of rac s (type,	single-particle states rmalism for fields sation heory and S-matrix ciple and interaction in theory les ectrodynamic processes corrections sation (optional) hing outcomes have mastered the principy w to use perturbation the	ples and underlying r ory and how to apply n electrodynamics in enormalisation.	nathematics of relati / Feynman rules. The leading order. Moree	ivistic quantum field theories. y are able to calculate basics over, they have a basic under- n)
Method	l of ass				tion offered — if not every seme-
		on on whether module ca		a bonus)	
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocation of places					
Additio	nal info	ormation			
Worklo	Workload				
240 h					

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 181 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 182 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation					
Theory of Relativity					11-RTT-161-m01			
Module	coordi	nator		Module offered by				
Managi and Ast		ctor of the Institute of T ics	heoretical Physics	Faculty of Physics and Astronomy				
ECTS		d of grading	Only after succ. con	Only after succ. compl. of module(s)				
6	numer	ical grade						
Duratio	i	Module level	Other prerequisites	Other prerequisites				
1 semes	ster	graduate						
Conten	ts							
 2. Differ 3. Brief 4. Elem 5. Electr 6. Field 7. Stella 	rential Summ ents of rodyna equati ar equil	ary of the special relativ differential geometry mics as an example of a ons of the fundamental ibrium and other astrop	a relativistic gauge the structure of general re					
		to cosmology						
The stu main to electroo	dents k pics in dynami	ling outcomes become familiar with the clude modern formulati cs as a gauge theory an els of stellar equilibriur	on on the basis of diff d general relativity are	erential forms. Furth e emphasised. The s	ermore, the similarit tudents learn to app	ies between		
Courses	s (type,	number of weekly cont	act hours, language –	- if other than Germa	n)			
V (3) + I Module		: in: German or English						
		essment (type, scope, l on on whether module o			tion offered — if not	every seme-		
b) oral of c) oral of d) project e) presect If a writt stead ta of assect nation of Langua	examin examin ect repo entation ten exa ake the ssment date at ge of a:	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu mination was chosen a form of an oral examina- is changed, the lecture the latest. ssessment: German and ffered: In the semester i	each (approx. 30 minu of 2, approx. 30 minu es) or tes). s method of assessme ation of one candidate er must inform student	tes per candidate) of ent, this may be char e each or an oral exa is about this by four	nged and assessmer mination in groups. I weeks prior to the or	If the method iginal exami-		
Allocati	ion of p	laces						
Additio	nal info	ormation						
Workload								
180 h								
Teachir	ig cycle	2						
Referre	d to in	LPOI (examination reg	ulations for teaching-o	degree programmes)				
Master's wi	th 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 183 / 215		

Module appears in

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 184 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	title				Abbreviation
	Black Holes 11-SLQ-232-mo1				
Module	coord	inator		Module offered by	
Managing Director of the Institute of Theoretical F and Astrophysics			eoretical Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites	i	
1 semes	ster	graduate			
Conten	ts				
 Vacu kelst catio Gravi Charş ADM Black PART 2 	um sol ein coc n and (tationa ged an formal c hole t - Astro	ordinates, Kruskal extens Carter-Penrose diagram al collapse - the Oppenhe d rotating black holes - C ism - energy and angular hermodynamics physical observations of	ion and eternal black imer-Snyder solutior auchy horizons, ergo momentum black holes	k holes, the Penrose	ff's theorem, the Eddington-Fin- diagram, conformal compactifi-
2. Black	c hole e	ass measurements of bla electromagnetism al waves and their measu			
 Introd Deriv Deriv Hawk Hawk The " Firew 	 PART 3 – Quantum aspects of black hole 1. Introduction to QFT on curved spacetime: Rindler spacetime, Unruh effect 2. Derivation of Hawking radiation 3. Hawking's original formulation of the information paradox 4. The "holography of information" - information paradox in AdS/CFT, the Page curve and Islands 5. Firewall, fuzzball, complementarity - possible resolutions of information paradox 6. Wormholes and the factorization puzzle 				
Intende	ed leari	ning outcomes			
ons in t Through connec in the a	he field n this c tion wi foreme	ds of Astronomy, Astroph course, the students will g th research directions in entioned directions and h	ysics, General Relati gain sufficient comm this area. This in turr lelp them to success	vity, String Theory ar ands over the applic n will motivate them ful begin their Maste	
		, number of weekly conta	ct hours, language –	- if other than Germa	in)
V (3) + I Module	.,	t in: German or English			
	Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)				
ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English					

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Physik - 2016	page 185 / 215

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

--

Additional information

Workload

180 h

Teaching cycle

--

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

Module appears in

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 186 / 215
	reg. data record Master (120 ECTS) Physik - 2016	1

Module title			Abbreviation				
Spintronics 11-SPI-161-m01							
Module coordinator				Module offered by			
Managir	ng Dire	ector of the Institute of	f Applied Physics Faculty of Physics and Astronomy				
		od of grading	Only after succ. con	pl. of module(s)			
6	numer	rical grade					
Duratior		Module level	Other prerequisites				
1 semes	ter	graduate					
Content	S						
magneto	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.						
Intende	d learr	ning outcomes					
mation t	techno	now the basic principl logy. They have gainec sistance).					
Courses	(type,	number of weekly con	tact hours, language –	- if other than Germa	n)		
V (3) + R Module		t in: German or English					
		essment (type, scope, on on whether module			tion offered — if not	every seme-	
e) prese If a writt stead ta of asses nation d Languag	 c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					If the method riginal exami-	
Addition	nal info	ormation					
Workloa	ıd						
180 h							
Teachin	g cycle	2					
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
		Physics (2016)	JMU Würzbı	rg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik	exam.	page 187 / 215	

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Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Quantum Technology (2021)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 188 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Surface	e Scien	ce			11-SSC-172-m01	
Module	e coordi	inator		Module offered by	•	
Manag	ing Dire	ector of the Institute of	of Applied Physics Faculty of Physics and Astronomy			
ECTS		od of grading	Only after succ. compl. of module(s)			
6	L	rical grade				
Duratio		Module level	Other prerequisites	i		
1 seme		graduate				
Conten						
			, distinction between b			
			d adsorbates, surface of surfaces, adsorption			
			onic structure of surface			
couplir	ig: Rasł	nba effect and topologi	cal insulators. Magnet	ism on surfaces.		
Intende	ed learr	ning outcomes				
			w of the diverse aspec			
			s of surfaces and interf			nportant ex-
•			cific application possib			
		, number of weekly con	tact hours, language –	- If other than Germa	in)	
V (3) + Module		t in: English				
			language — if other th can be chosen to earn		tion offered — if not	every seme-
		nination (approx. 90 to				
			each (approx. 30 mini	utes) or		
			s of 2, approx. 30 minu		r	
		ort (approx. 8 to 10 pag				
		n/talk (approx. 30 min		ant this may be sha	and and according	at may in
			as method of assessm nation of one candidate			
			er must inform student			
		the latest.				
		ssessment: German ar	d/or English in which the course is	offered and in the cu	head want competer	
				onered and in the st	insequent semester	
Allocat		naces				
		ormation				
Additio	nat into	ormation				
Worklo	ad					
180 h						
Teachi	Teaching cycle					
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	rs in				
	Master's degree (1 major) Physics (2016)					
	-		ure Technology (2016)			
Master	's teach	ning degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)
Master's wi	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 189 / 215

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Quantum Technology (2021)

exchange program Physics (2023)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 190 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation	
String Theory 1				11-STRG1-171-m01	
Module coordinator			Module offered by		
Managing Director of the Insti and Astrophysics	itute of Th	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS Method of grading		Only after succ. con	npl. of module(s)		
8 numerical grade					
Duration Module level		Other prerequisites			
1 semester graduate					
Contents					
action; quantisation of the clu dimension; quantisation of th conformal field theory, string	osed bosc ne open bo	onic string and emerg osonic string, D-Bran	gent graviton; quantu es, Gauge Fields and	Nambu-Goto action and Polyakov um Lorentz invariance and critical d Yang-Mills theories; relativistic ns, effective actions and gravity.	
Intended learning outcomes					
cal actions for relativistic bos bosonic string and understan have calculated Lorentz anon understand the boundary cor open string quantisation and dent branes. They are familia	onic string d the eme naly on qu iditions fo of the spe r with rela ing intera	gs, the Nambu-Goto ergence of the massle antum level to dedu or the open string and ectrum of massless g tivistic conformal fie	action and Polyakov ess graviton in the sp ce the critical dimen d its connection to D- gauge fields, as well a ld theory, the string	nic strings. They know the classi- action, they have quantised the bectrum of the closed string. They sion of the bosonic string. They branes. They have knowledge of as of Yang-Mills fields for coinci- path integral, its BRST quantisa- effective actions in target space	
Courses (type, number of wee	ekly conta	ct hours, language –	- if other than Germa	n)	
V (4) + R (2) Module taught in: German or	English				
Method of assessment (type, ster, information on whether	•			tion offered — if not every seme-	
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					
Allocation of places	Allocation of places				
Additional information					
Workload					
240 h					
Teaching cycle					

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 191 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module appears in

Master's degree (1 major) Physics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 192 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation	
String Theory 2			11-STRG2-171-m01	
Module coordinator		Module offered by	Module offered by	
Managing Director of the Institute of Tl and Astrophysics	neoretical Physics	Faculty of Physics a	and Astronomy	
ECTS Method of grading	Only after succ. con	npl. of module(s)		
6 numerical grade				
Duration Module level	Other prerequisites	i		
1 semester graduate				
Contents				
Superstring theories and M theory, in p mionic fields and representations of C and more dimensions, the classical ar A/B superstrings, the Gliozzi-Scherck- pe I superstring, heterotic string theories ween the five superstring theories as w	lifford algebra in dive Id quantum version o Olive projection and s es, anomaly cancella vell as their relation t	rse dimensions, a re f the Ramond-Nevea space-time supersym tion and restrictions o M theory in 11D, D-	view of supersymmetry in two u-Schwarz superstring, type II nmetry in 10 dimensions, the ty- on gauge groups, dualities bet-	
ge theories, supergravity and the AdS/	CFT correspondence.	,		
Intended learning outcomes	<u> </u>			
The students are familiar with supersymmetrical string theory and M theory. They know the basic characteristics of bosonic string theory and fermionic field theory as well as the depiction of Clifford algebra in different dimensions. They have studied the aspects of supersymmetry in two or more dimensions relevant to superstring theory. They are acquainted with classical and quantum theory of the Ramon-Neveau-Schwarz superstring, they understand the deduction of type IIA/B string theories and the ensuring of space-time supersymmetry on the basis of Gliozzi-Scherk-Olive projection. They have gained insights into type I and heterotic superstring theory and into the limiting effects of anomaly freedom on the permitted gauge groups of these theories. They have studied the dualities between the five superstring theories and their connections to M theory in 11 dimensions. They are familiar with the properties of supersymmetric D-branes in type I and II superstring theories and the connection to AdS/CFT correspondence.				
Courses (type, number of weekly conta	act hours, language –	- if other than Germa	ın)	
V (3) + R (1) Module taught in: German or English				
Method of assessment (type, scope, la	anguage — if other th	an German, examina	tion offered — if not every seme-	
ster, information on whether module c			·····,···,	
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 				
Allocation of places				
Additional information				

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.
	reg. data record Master (120 ECTS) Physik - 2016

Workload

180 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Physics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Mathematical Physics (2020)

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 194 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module					Abbreviation
Superconductivity				11-SUP-161-m01	
Module	e coord	inator		Module offered by	
Managi	ing Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	î	od of grading	Only after succ. con	pl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
		iples of superconductors Is of material sciences fo			velopment of technological plat- erconductors)
Intende	ed learr	ning outcomes			
		nave a basic understandi aluate the contributions c			c quantum phenomenon. They of superconductivity.
Course	s (type,	, number of weekly conta	ct hours, language –	· if other than Germa	n)
V (3) + Module		t in: German or English			
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-
c) oral o d) proje e) prese If a writ stead ta of asse nation Langua	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 				
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
180 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regu	lations for teaching-o	legree programmes)	
Module	e appea	irs in			
Master Master	's degre 's teach	ee (1 major) Physics (2010 ee (1 major) Nanostructur ning degree Gymnasium M y course MINT Teacher Ec	e Technology (2016) MINT Teacher Educat		

Module title				Abbreviation	
Thermodyna	mics and Economics			11-TDO-161-m01	
Module coor	dinator		Module offered by		
Managing Di and Astrophy	rector of the Institute of vsics	Theoretical Physics	Faculty of Physics a	Ind Astronomy	
	od of grading	Only after succ. con	npl. of module(s)		
6 (not)	successfully completed				
Duration	Module level	Other prerequisites			
1 semester	graduate				
Contents					
Part I describ folding of civ cance of the on, entropy p economic gro Part 2 analys economy and ve labour. Wi and costs of cial tensions Part 3 include use, and intre Intended lea The students in the world's connections mies. They an	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 un- folding of civilisation. The density of entropy production of non-equilibrium thermodynamics shows the signifi- cance of the second law of thermodynamics for ecological damage and resource consumption. Energy conversi- on, 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 expensi- ve 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 so- cial 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). Intended learning outcomes 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 econo- mies. They are able to apply the acquired knowledge to particular problems. NOTE: this is the module that was run by Prof. Dr. R. Kümmel, who has now retired. As the module was tailored to				
	e, number of weekly cor	tact hours, language –	- if other than Germa	ın)	
V (3) + R (1) Module taug	ht in: German or English				
	sessment (type, scope, tion on whether module			tion offered — if not	every seme-
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places 					
Additional information					
Master's with 1 maj	or Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 196 / 215

Workload

180 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 197 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Topolo	gical E	ffects in Electronic Syste	ms		11-TEF-161-m01	
Module	a coord	inator		Module offered by		
		ector of the Institute of Th	neoretical Physics	Faculty of Physics a	and Astronomy	
and As					and notionomy	
ECTS		od of grading	Only after succ. con	npl. of module(s)		
6	I	rical grade				
Duratio		Module level	Other prerequisites	i		
1 seme		graduate				
Conten						
					gical insulators, superconduc- um. The course aims to deeper	
					or to keep up with contempora	
		s. The specific choice of t				. ,
Intend	ed lear	ning outcomes				
			t acquainted with top	pics of immediate rel	levance to research conducted	l at
		of Würzburg.				
		, number of weekly conta	ct hours, language –	- if other than Germa	ın)	
V (3) + Moduly	• •	t in, Cormon or English				
	_	t in: German or English			tion offered if not survey on	
		ion on whether module c			tion offered — if not every sem	ne-
	-	mination (approx. 90 to 1				
		nation of one candidate e		utes) or		
		ation in groups (groups (tes per candidate) o	r	
		ort (approx. 8 to 10 pages				
		n/talk (approx. 30 minut		ant this may be sha	nged and assessment may in-	
					mination in groups. If the meth	
					weeks prior to the original exa	
		the latest.		,	, .	
0	0	ssessment: German and				
		ffered: In the semester in	which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
	-					
Referre	ed to in	LPOI (examination regu	llations for teaching-	degree programmes)		
Module						
	-	ee (1 major) Mathematics				
	-	ee (1 major) Physics (201				
	-	ee (1 major) Mathematica ee (1 major) Computatior		6)		
					ovam	215
master's w	ии і тајо	r Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physi		215

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 199 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module	e title				Abbreviation	
Theore	tical El	ementary Particle Phys	sics		11-TEP-161-m01	
Module	e coord	inator		Module offered by		
Managi and Ast		ector of the Institute of sics	Theoretical Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
2. Symi 3. Quar 4. Quar 5. Princ 6. Gaug 7. Spon 8. Elect 9. Quar	metries k mode k parto iples o ge theo taneou troweal ntum cl	us symmetry breaking k standard model hrome dynamics	-			
	-	s of the standard mode	l			
Intende	ed lear	ning outcomes				
structu lation n re, they	re of th nethod / know	are familiar with the ma e standard model base s for the processing of the tests and limits of , number of weekly cor	ed on symmetry princip simple problems and p the standard model an	les and experimenta processes of Element d the basics of exten	l observations. They tary Particle Physics. ded theories.	know calcu-
		, number of weekly cor	lact nours, language –		(11)	
	e taugh	t in: German or English				
		sessment (type, scope, ion on whether module			tion offered — if not	every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocation of places						
Additio	nal inf	ormation				
Worklo	ad					
240 h						
Teaching cycle						
	- <u>5</u> - y - t	•				
Master's wi	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 200 / 215

Module appears in

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 201 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title				Abbreviation		
Theoretical Solid State Physics 11-TFK-161-m01						
Module coordinator Module offered by			Module offered by			
Managing Dire and Astrophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy		
	od of grading	Only after succ. con	npl. of module(s)			
8 nume	rical grade					
Duration	Module level	Other prerequisites				
1 semester	graduate					
Contents						
bus which cou A possible syl 1 Band structu pological insu 2 Electron-ele ry, random ph 3 Application	ıld alternatively be offere labus may be: ıre (Sommerfeld theory o lators (TIs), bulk-surface	d as "Quantum Many f metals, Bloch theor correspondence, ger ls (path integral met , density functional t	y Body Physics" (11-Q rem, k.p approach an neral properties of Th hod for weakly intera heory)	d effective Hamiltonians for to-		
Intended learn	ning outcomes					
sics, which are cepts and the sics" and "Qua	e addressed in classical t methods of description. antum Mechanics".	extbooks, and there The course builds up	by advance their kno oon the courses "Exp	many topics of Solid-State Phy- wledge of the underlying con- erimental Condensed Matter Phy-		
Courses (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)		
V (4) + R (2) Module taugh	t in: German or English					
	s essment (type, scope, la on on whether module ca			tion offered — if not every seme-		
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English 						
	Assessment offered: In the semester in which the course is offered and in the subsequent semester					
Allocation of p	JIALES					
 Addition -1 !: f						
Additional inf						
Workload						
240 h						
Teaching cycl	e					

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 202 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module appears in

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module appears in
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Physics (2016)
Master's degree (1 major) Nanostructure Technology (2016)
Master's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's degree (1 major) Nanostructure Technology (2020)
Master's degree (1 major) Physics (2020)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Mathematical Physics (2020)
Master's degree (1 major) Quantum Technology (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Mathematical Physics (2022)
exchange program Physics (2023)
Master's degree (1 major) Computational Mathematics (2024)
Master's degree (1 major) Mathematics (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 203 / 215
	reg. data record Master (120 ECTS) Physik - 2016	

Module title			Abbreviation			
Theoretical Solid State Physics 2 11-TFK2-161-m01						
Module coordinator Module offere			Module offered by	<u> </u>		
Managing Director of the Institute of Theoretical Physics and Astrophysics			Theoretical Physics	Faculty of Physics a	and Astronomy	
ECTS	1	od of grading	Only after succ. con	npl. of module(s)		
8		rical grade				
Duratio		Module level	Other prerequisites	;		
1 seme		graduate				
Conten						
5. Adva Anders 6. Unco 7. Gree	anced t son-Hig onventi en's fun	n of the first semester (opics of the theory of s gs description of the M onal superconductors ction methods and Fey Effect (Anderson's "po	uperconductivity (Bogo eissner effect) (e.G. copper-oxide high nman diagrammatic te	oliubov-de Gennes ec n-Tc superconductors chnique		eld theory,
Intend	ed lear	ning outcomes				
sics, w cepts a	hich ar and the	o-semester lecture, the e addressed in classica methods of descriptio antum Mechanics".	al textbooks, and there	by advance their kno	wledge of the under	lying con-
Course	s (type	, number of weekly cor	itact hours, language –	- if other than Germa	ın)	
V (4) + Module		t in: German or English				
		s essment (type, scope, ion on whether module			ition offered — if not	every seme-
 b) oral c) oral d) projection e) pression lf a write stead to of assess nation Langua 	ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester					If the method riginal exami-
Allocat	tion of	places				
Additio	onal inf	ormation				
Workload						
240 h						
Teaching cycle						
	•					
Referre	ed to in	LPO I (examination re	gulations for teaching-	degree programmes)		
Module	e appea	ars in				
Master's w	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physil		page 204 / 215

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Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title			Abbreviation			
Topology in Solid State Physics 11-TFP-161-m01						
Module coordinator Module offered by						
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	ind Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i i i i i i i i i i i i i i i i i i i		
1 seme	ster	graduate				
Conten	ts					
2. Math 3. Time 4. Hall 5. Bulk 6. Grap 7. Quan 8. Z2 ir 9. Topo Intendo	nematic -revers conduc -bound ohene (a ntum Sp nvariant ological ed learr	hase in quantum syste al basics of topology al symmetry tance and Chern numb ary correspondence as a topological insulat bin Hall insulators s superconductors hing outcomes acquire a theoretical un	ers or)	rical conconts in mo	dom Solid Stato Phy	reice Those
	ots serv	e as a basis of many re				
Course	s (type	number of weekly con	tact hours, language –	- if other than Germa	in)	
V (3) + Module		t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
 b) oral c) oral d) proje e) press lf a write stead t of assess nation Langua 	examin examin ect repo entatio tten exa ake the essment date at age of a	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 minu mination was chosen a form of an oral examin t is changed, the lectur the latest. ssessment: German an ffered: In the semester	each (approx. 30 minu s of 2, approx. 30 minu es) or utes). as method of assessm ation of one candidate er must inform student d/or English	tes per candidate) o ent, this may be cha e each or an oral exa is about this by four	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Workload						
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Master's w	ith 1 major	Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physi		page 206 / 215

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 207 / 215
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Modul	e title				Abbreviation	
Topological Order 11-TOPO-161-mo1						
Module coordinator Module offered by						
Manag	ging Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	ind Astronomy	
ECTS		od of grading	Only after succ. con	npl. of module(s)		
6		rical grade				
Durati		Module level	Other prerequisites			
1 seme		graduate				
order p concep The to 1. Frac 2. Spir 3. Non 4. Maj 5. Topo 6. Spir Intend The stu Course	ContentsTopologically ordered phases possess no order in the conventional sense (i.e., no broken symmetry and no local order parameter). The order is instead characterized by topological quantum numbers. In the course, the general concepts will be illustrated with the study of specific examples of systems with topological order. The topics discussed may include: 1. Fractional charge and statistics in quantized Hall fluids 2. Spin charge separation in spin chains and chiral spin liquids 3. Non-Abelian statistics of fractionalized excitations 4. Majorana zero modes in p-wave superconductors 5. Topological degeneracies on higher genus surfaces (e.g., torus geometry) 6. Spinons and visons in spin liquids including Kitaev models.Intended learning outcomesThe students acquire in-depth knowledge of topological order in quantum condensates.Courses (type, number of weekly contact hours, language — if other than German)					
V (3) + Modul		t in: German or English				
		essment (type, scope,			tion offered — if not	every seme-
a) writt b) oral c) oral d) proj e) pres If a wri stead of asse nation Langua	 ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 					If the method riginal exami-
Alloca	tion of p	olaces				
Additi	onal inf	ormation				
Worklo	bad					
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Modul	e appea	irs in				
Master's w	vith 1 majo	Physics (2016)		urg • generated 19-Apr-2025 (cord Master (120 ECTS) Physil		page 208 / 215

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 209 / 215
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Module					Abbreviation		
Experimental Particle Physics 11-TPE-161-m01							
Module coordinator Module offered by							
Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy			nd Astronomy				
ECTS		od of grading	Only after succ. compl. of module(s)				
6		rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten	ts						
supers	ymmet as oth	nodern particle detectors ry and other physics bey er parameters of the star errors.	ond the standard mod	del. Determination of	the top quark mass	and W mass	
Intende	ed lear	ning outcomes					
questic	ons of F	are familiar with the prin Particle Physics, which a able to put results into co	re examined by using	these detectors. The	y know modern met		
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	n)		
V (3) + Module		t in: German or English					
		sessment (type, scope, la on on whether module c			tion offered — if not	every seme-	
c) oral d d) proje e) pres If a writ stead t of asse nation Langua	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocat	ion of p	olaces					
Additio	onal inf	ormation					
Worklo	ad						
180 h							
Teachi	ng cycl	e					
Referred to in LPO I (examination regulations for teaching-degree programmes)							
-							
Module							
Master	's degr	ee (1 major) Mathematic ee (1 major) Physics (201 ee (1 major) Computation	.6)	6)			
Master's w	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physik		page 210 / 215	

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Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Mathematics (2022)

exchange program Physics (2023)

Master's degree (1 major) Computational Mathematics (2024)

Master's degree (1 major) Mathematics (2024)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 211 / 215
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Module title				Abbreviation		
Topological Quantum Physics 11-TQP-161-m01						
Module coordinator				Module offered by	<u>,</u>	
Managing Director of the Institute of Theor and Astrophysics			Theoretical Physics	Faculty of Physics a	and Astronomy	
			Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	Other prerequisites		
1 semes	ster	graduate				
Conten	ts					
ding on tors ass	The course is aimed at Masters students pursuing either experimental or theoretical work in their thesis. Depen- ding on the lecturers emphasis, it is meant to provide an introduction to topological superconductors and insula- tors assuming only "Quantum mechanics II" (11-QM2) as a prerequisite. The contents may include:					
2. Majo	 Introduction to superconductivity (including BCS theory) Majorana fermions and topological superconductors in 1D (Kitaev wires) Topological superconductors in two dimensions (2D) (including Majorana edge states and non-Abelian statistics) 					oelian stati-
 4. Integer quantum Hall effect and Chern insulators (Haldane model, Jackiw-Rebbi solitons and edge states) 5. Berry's phase and Chern invariants 6. Time reversal symmetry and topological insulators in 2D 7. Topological insulators in 3D 						
	-	ning outcomes				
In-dept	h unde	rstanding of the topolo atter Physics at the Uni		ntum Physics relevan	it to current research	n projects of
Courses	s (type	, number of weekly con	tact hours, language –	- if other than Germa	ın)	
V (3) + I						
Module	taugh	t in: German or English				
		essment (type, scope, on on whether module			tion offered — if not	every seme-
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocation of places						
Additio	nal inf	ormation				
Workload						
180 h						
Teaching cycle						
Master's wi	th 1 majoi	Physics (2016)		urg • generated 19-Apr-2025 • cord Master (120 ECTS) Physil		page 212 / 215

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 213 / 215
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Module title				Abbreviation		
Theory of Superconductivity				11-TSL-161-m01		
Module coordinator				Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics			Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	CTS Method of grading Only after succ. compl. of module(s)					
6	nume	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Overview of the phenomenology of conventional and unconventional superconductivity. Empirical Matthias rules for superconductivity. Review of BCS theory and critical discussion of its applicability for different types of super- conductors. Extension of the phenomenological Ginzburg-Landau theory to a quantum field theory using Feyn- man diagrams and functional integrals. Ward identities and response functions. Goldstone modes, phase fluc- tuations, and coupling to the electromagnetic field. Interpretation of the Meissner effect using the Higgs mecha- nism. Interplay of magnetism and conventional/unconventional superconductivity. Discussion of current rese-						
		d perspective on room		luuctivity.		
Intended learning outcomes This lecture focuses on the understanding of unconventional superconductivity and the interactions with magne- tism in the current research context. The first part of the lecture addresses conventional molecular field theory of superconductivity (BCS theory), which fails when applied to new material classes such as high-temperature su- perconductors. Subsequently, it introduces tools of quantum field theory necessary to expand BCS theory. The- reby it especially focuses on Meissner effect and Higgs mechanism. The last part of the lecture discusses current developments concerning the description and analysis of (un)conventional superconductors and their fascina- ting connection to competing magnetic phases.						
				- if other than Germa	un)	
Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1)						
		t in: German or English				
Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)					every seme-	
 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester 						
Allocation of places						
Additional information						
Workload						
180 h						
Teaching cycle						
Master's wi	ith 1 majo	r Physics (2016)		urg • generated 19-Apr-2025 < cord Master (120 ECTS) Physil		page 214 / 215

Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Mathematical Physics (2016)

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's with 1 major Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam.	page 215 / 215
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