

Subdivided Module Catalogue for the Subject

Quantum Technology

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

Examination regulations version: 2021 Responsible: Faculty of Physics and Astronomy

JMU Würzburg • generated 30-Mär-2024 • exam. reg. data record 88|k29|-|-|H|2021



Learning Outcomes

German contents and learning outcome available but not translated yet.

Wissenschaftliche Befähigung

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

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind in der Lage, auch bei unvollständigen Informationen physikalische und technische 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 verantwortlicher Wissenschaftler bzw. verantwortliche Wissenschaftlerin in interdisziplinär und international zusammengesetzten Teams aus (Natur-)Wissenschaftlern bzw. (Natur-)Wissenschaftlerinnen und/oder Ingenieuren bzw. Ingenieurinnen in Forschung, Industrie und Wirtschaft mitzuwirken.
- Die Absolventinnen und Absolventen sind in der Lage, physikalische und technische Methoden selbstständig auf konkrete 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 eigenen Projekten umzusetzen und verfügen über Kenntnisse des aktuellen Forschungsstandes in mindestens einem Spezialgebiet der Quantentechnologie.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind in der Lage, auch bei unvollständigen Informationen Probleme der Quantentechnologie 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 und technische 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 und technische Fragestellungen zu diskutieren und Nichtwissenschaftlern physikalische Fragen zu erläutern.
- Die Absolventinnen und Absolventen haben die Bereitschaft und Fähigkeit entwickelt, ihre Kompetenzen in partizipative Prozesse einzubringen und aktiv an Entscheidungen mitzuwirken.

UNIVERSITÄT

WÜRZBURG

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)):

28-Apr-2021 (2021-53) 09-Jun-2021 (2021-65) 06-Sep-2022 (2022-57)

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

Master's with 1 major Quantum Technology (2021)

The subject is divided into

Abbreviation	Module title	ECTS	Method of	nage							
	module litte	credits	grading	pase							
Compulsory Electives (60	Compulsory Electives (60 ECTS credits)										
Subfield Quantum Technology (min. 55 ECTS credits)											
Advanced Laboratory Course (min. 9 ECTS credits)											
11-P-FM1-161-m01	Advanced Laboratory Course Master Part 1	3	B/NB	82							
11-P-FM2-161-m01	Advanced Laboratory Course Master Part 2	3	B/NB	83							
11-P-FM3-161-m01	Advanced Laboratory Course Master Part 3	3	B/NB	84							
11-P-FM4-161-m01	Advanced Laboratory Course Master Part 4	3	B/NB	85							
Advanced Seminar (min	. 5 ECTS credits)										
11-OSN-A-212-m01	Advanced Seminar Quantum Technology A	5	NUM	80							
11-OSN-B-212-m01	Advanced Seminar Quantum Technology B	5	NUM	81							
Focus Nanostructure Te	chnology		<u>.</u>								
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	66							
11-HPH-201-m01	Semiconductor Physics	6	NUM	68							
11-QTR-201-m01	Quantum Transport	6	NUM	94							
11-NOP-161-m01	Nano-Optics	6	NUM	76							
11-SPI-161-m01	Spintronics	6	NUM	96							
11-BSV-161-m01	Image and Signal Processing in Physics	6	NUM	36							
11-PMM-161-m01	Physics of Advanced Materials	6	NUM	86							
11-OHL-161-m01	Organic Semiconductors	6	NUM	78							
	Sensor and Actor Materials - Functional Ceramics and Magne-	5	NILINA								
08-FU-SAWI-161-III01	tic Particles		NUM	14							
08-PCM4-161-m01	Ultrafast spectroscopy and quantum-control	5	NUM	15							
08-FU-EEW-152-m01	Electrochemical Energy Storage and Conversion	5	NUM	11							
	Structure and Properties of Modern Materials: Experiments vs.	_	NILINA								
08-FU-IWW-161-III01	Simulations	5	NUM	13							
11-EXN5-212-m01	Current Topics in Quantum Technology	5	NUM	43							
11-EXN6-212-m01	Current Topics in Quantum Technology	6	NUM	44							
11-EXN7-212-m01	Current Topics in Quantum Technology	7	NUM	46							
11-EXN8-212-m01	Current Topics in Quantum Technology	8	NUM	47							
11-EXN6A-212-m01	Current Topics in Quantum Technology	6	NUM	45							
11-CSFM-161-m01	Advanced Topics in Solid State Physics	6	NUM	38							
11-CSNM-212-m01	Advanced Topics in Quantum Technology	6	NUM	40							
11-FK2-201-m01	Solid State Physics 2	8	NUM	60							
11-CSPM-161-m01	Advanced Topics in Physics	6	NUM	41							
11-FKS-161-m01	Solid State Spectrocopy	6	NUM	62							
11-TEFK-201-m01	Topological Effects in Solid State Physics	8	NUM	101							
11-FFK-201-m01	Field Theory in Solid State Physics	8	NUM	58							
11-AKTF-201-m01	Selected Topics of Theoretical Solid State Physics	6	NUM	28							
11-MAG-161-m01	Magnetism	6	NUM	70							
11-QM2-161-m01	Quantum Mechanics II	8	NUM	92							
11-TQO-221-m01	Theoretical Quantum Optics	8	NUM	105							
11-TFK-161-m01	Theoretical Solid State Physics	8	NUM	103							

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11-PTS-201-m01	Phenomenology and Theory of Superconductivity	6	NUM	88
11-QIC-201-m01	Advanced Theory of Quantum Computing and Quantum Infor- mation	6	NUM	90
11-MRI-171-m01	Advanced Magnetic Resonance Imaging	6	NUM	74
11-SSC-172-m01	Surface Science	6	NUM	99
11-SPT-211-m01	Scanning Probe Technologies	6	NUM	98
11-EIM-211-m01	Electron and Ion Microscopy	6	NUM	42
11-FPA-161-m01	Visiting Research	10	NUM	64
11-EXP5-161-m01	Current Topics in Physik	5	NUM	49
11-EXP6-161-m01	Current Topics in Physik	6	NUM	50
11-EXP7-161-m01	Current Topics in Physik	7	NUM	54
11-EXP8-161-m01	Current Topics in Physik	8	NUM	55
11-EXP6A-161-m01	Current Topics in Physik	6	NUM	52
Subfield Non-technical I	Minor			
10-M-VAN-152-m01	Advanced Analysis	7	NUM	27
10-M=VDIM-161-m01	Discrete Mathematics	5	NUM	25
10-I=PA-161-m01	Analysis and Design of Programs	5	NUM	19
10-I-APR-172-m01	Advanced Programming	5	NUM	21
10-l-BS-191-m01	Operating Systems	5	NUM	23
10-l=Kl1-161-m01	Artificial Intelligence 1	5	NUM	17
02-EReWi-G-161-m01	Introduction to Law for Economists	5	NUM	7
02-N-P-W06-182-m01	Trade Mark Law	3	NUM	9
02-N-P-W07-182-m01	Copyright Law	2	NUM	10
02-G&Hre-G-161-m01	Commercial and Business Law for Economists	5	NUM	8
11-AP-152-m01	Astrophysics	6	NUM	30
11-ASM-161-m01	Methods of Observational Astronomy	6	NUM	32
11-ASP-161-m01	Introduction to Space Physics	6	NUM	34
11-EXZ5-161-m01	Additional Qualifications	5	NUM	56
11-EXZ6-161-m01	Additional Qualifications	6	NUM	57
11-EXNT6-161-m01	Non-technical Minor Subject	6	NUM	48
Thesis (60 ECTS credits)				
11-FS-N-212-m01	Professional Specialization Quantum Technology	15	B/NB	65
11-MP-N-212-m01	Scientific Methods and Project Management Quantum Technology	15	B/NB	73
11-MA-N-212-m01	Master Thesis Quantum Technology	30	NUM	72

Module	e title				Abbreviation	
Introdu	Introduction to Law for Economists 02-EReWi-G-161-m01					
Module	e coord	inator		Module offered by		
Dean o	of the Fa	culty of Law		Faculty of Law		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	Its					
Germa	n conte	nts available but not trar	islated yet.			
Intende German Der/Die komme Struktu	ed learn n intend e Studio ens unc	ning outcomes ded learning outcomes av erende verfügt über Kenn l Inhalts sowie der Auflös echtsordnungen	vailable but not trans tnisse der nationaler sung und Folgen von '	ilated yet. n und internationale Verträgen, des Zusta	n Rechtsordnung, des Zustande- Indekommens von Gesetzen, der	
Course	s (type	number of weekly conta	ct hours, language –	- if other than Germa	in)	
V (3) +	Ü (2)	,			,	
Metho ster, in	d of ass formati	sessment (type, scope, la on on whether module ca	nguage — if other th an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
written Assess	exami ment o	nation (approx. 120 minu ffered: Usually once a ye	tes) ar, winter semester			
Allocat	ion of p	olaces				
There a chelor' other s the nur dents o	are no re s stude ubjects mber of of other	estrictions with regard to nts with the minor Privat 5. 10 of these will be alloc available places exceed subjects. Should there b	available places for recht (Private Law). A cated to students of t the number of appli oe more than 10 appli	students of Rechtsw total of 20 places w he Master's degree p cations, the remaining cations, the remaining	issenschaft (Law) as well as Ba- vill be allocated to students of programme Economics. Should ng places may be allocated to stung ng places will be allocated as fol	

lows: Students applying after not having successfully completed assessment in past years will be given preferential consideration. The remaining places will be allocated by lot. A waiting list will be maintained and places re-

allocated by lot as they become available.

Additional information

Workload

150 h

Teaching cycle

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

Module appears in

Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Quantum Technology (2021)

Module title				Abbreviation		
Comm	Commercial and Business Law for Economists 02-G&Hre-G-161-m01					
Modul	e coord	inator		Module offered by		
Dean c	of the Fa	culty of Law		Faculty of Law		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
5	nume	rical grade				
Durati	on	Module level	Other prerequisites			
1 seme	ester	unknown				
Conter	nts					
Germa	n conte	nts available but not tran	islated yet.			
Dieses	Modul	bietet eine Einführung in	das deutsche und e	uropäische Gesellscl	hafts- und Handelsrecht.	
Intend	ed learı	ning outcomes				
Germa	n inten	ded learning outcomes av	vailable but not trans	lated yet.		
D /D.				6 I.I. I.I.		
Der/Di	e Studio sformer	erende verfugt uber Kenn Vertretungsmacht Haft	thisse des Gesellsch	afts- und Handelsred Auflösungen von Ges	ellschaften sowie über Grundla-	
gen de	s Recht	s der Handelsgeschäfte i	and der Handelsgese	llschaften.	cuscilation source user standia	
Course	es (type	, number of weekly conta	ct hours, language –	· if other than Germa	n)	
V (3) +	Ü (2)					
Metho ster, in	d of ass Iformati	s essment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
writter	exami	nation (approx. 120 minu	tes)			
Assess	ment o	ffered: Usually once a yea	ar, summer semester			
Alloca	tion of p	olaces				
There a	are no r	estrictions with regard to	available places for	students of Rechtswi	issenschaft (Law) as well as Ba-	
chelor'	s stude	nts with the minor Privat	recht (Private Law). A	total of 20 places w	ill be allocated to students of	
the nu	mber of	available places exceed	the number of applic	ations, the remaining	ig places may be allocated to stu-	
dents	of other	subjects. Should there b	e more than 10 appli	cations, the remaini	ng places will be allocated as fol-	
lows: S	Student	s applying after not havin	ig successfully comp	leted assessment in	past years will be given preferen-	
tial coi allocat	rsiderat ed by lo	tion. The remaining place	s will be allocated by the	lot. A waiting list wi	Il be maintained and places re-	
	nal inf	ormation				
Worklo	oad					
150 h						
Teachi	ng cycl	9				
	0.7	-				
Referre	ed to in	LPO I (examination regu	lations for teaching-o	legree programmes)		
		<u>U</u>		0 1 0 /		
Modul	e appea	urs in				
Master	r's degr	ee (1 major) Nanostructur	re Technology (2016)			
Bache	lor' deg	ree (1 major) Computer S	cience (2017)			
Bache	lor' deg	ree (1 major) Computer S	cience (2019)			
Master	's degr	ee (1 major) Nanostructur	re Technology (2020)			
master	s uegr	ee (1 major) Quantum Tec	.mology (2021)			

Module title			Abbreviation			
Trade Mark Law	Trade Mark Law 02-N-P-W06-182-m01					
Module coordinator		Module offered by				
Dean of Studies Faculty of Law		Faculty of Law				
ECTS Method of grading	Only after succ. con	npl. of module(s)				
3 numerical grade						
Duration Module level	Other prerequisites					
1 semester undergraduate						
Contents						
German contents available but not tra	anslated yet.					
Die Vorlesung vermittelt einen Überb gen des Markenbegriffs und -schutze Wirkungen der Europäischen Gemein werden Spezialregelungen des deuts schen Herkunftsangaben sowie zum	lick über das Deutsche s nach dem deutscher schaftsmarke nach de chen Markenrechts wi kennzeichenrechtliche	e und Europäische M n Markengesetz werd r Gemeinschaftsmar e z.B. zu geschäftlich n Schutz von Interne	arkenrecht. Neben d len u.a. die Vorausse kenverordnung beha nen Bezeichnungen, et Domains besproch	len Grundla- etzungen und andelt. Ferner geographi- nen.		
Intended learning outcomes						
German intended learning outcomes	available but not trans	lated yet.	rten des deutschen i	und euronäi-		
schen Rechts analysieren.						
Courses (type, number of weekly con	tact hours, language –	- if other than Germa	n)			
V (2)						
Method of assessment (type, scope, ster, information on whether module	language — if other the can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-		
a) written examination (approx. 120 n Assessment offered: Usually once a y	ninutes) or b) oral exar vear, summer semester	nination (approx. 15	minutes)			
Allocation of places						
max. 10 places. There are no restriction Rechtswissenschaft (Law) pursuing the well as Bachelor's students with the dents of other subjects. Should there will be allocated as follows: Students two semesters will be given preferent list will be maintained and places re-	ons with regard to avai he degree Erste Juristis minor Privatrecht (Priva be more than 10 appli applying after not hav tial consideration. The allocated as they beco	lable places for stud che Staatsprüfung (f ate Law). A total of 10 cations from studen ring successfully con remaining places wi me available.	ents of the degree p first state examination o places will be alloc ts of other subjects, npleted assessment Il be allocated by lot	rogramme on in law) as ated to stu- these places in the past . A waiting		
Additional information						
Workload						
90 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Bachelor's degree (1 major, 1 minor) I	Private Law (Minor, 20:	18)				
Bachelor's degree (1 major, 1 minor) Private Law (Minor, 2019)						
Master's degree (1 major) Nanostructure Technology (2020)						
Master's degree (1 major) Quantum Technology (2021)						
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Module	e title			Abbreviation		
Copyright Law 02-N-P-W07-182-m01					01	
Module	coordinator		Modulo offered by			
Doan o	f Studios Esculty of Law		Faculty of Law			
FCTS	Method of grading	Only after succ. con	nl of module(s)			
2	numerical grade					
Duratio	on Module level	Other prerequisites				
1 seme	ster undergraduate					
Conten	ts					
Germai	n contents available but not tra	nslated yet.				
Die Ver von We muster	anstaltung behandelt neben de erken nach dem deutschen Urh recht sowie das Patent- und Ge	en allgemeinen Grund ebergesetz. In einem brauchsmusterrecht I	llagen des Gewerblic weiteren Veranstaltu peleuchtet.	hen Rechtsschutzes ngsteil werden das	s den Schutz Geschmacks-	
Intende	ed learning outcomes					
Germai	n intended learning outcomes a	vailable but not trans	lated yet.			
Die Stu worber	dierenden haben grundlegend n. Sie können Problematiken au	e Kenntnisse des Gew s diesen Bereichen ir	verblichen Rechtssch 1 den Kontext der de	utzes und des Urhe utschen und europä	berrechts er- ischen Rege-	
lungen	einordnen.					
Course	s (type, number of weekly cont	act hours, language –	- if other than Germa	ın)		
V (1)						
Metho ster, in	d of assessment (type, scope, l formation on whether module of	anguage — if other th an be chosen to earn	an German, examina a bonus)	ition offered — if not	every seme-	
a) writt Assess	en examination (approx. 120 m ment offered: Usually once a ye	inutes) or b) oral exar ear, summer semester	mination (approx. 15	minutes)		
Allocat	ion of places					
max. 10 Rechts well as dents o will be two ser list will	o places. There are no restrictio wissenschaft (Law) pursuing th Bachelor's students with the m of other subjects. Should there allocated as follows: Students mesters will be given preferenti be maintained and places re-a	ns with regard to avai e degree Erste Juristis hinor Privatrecht (Priva be more than 10 appli applying after not hav al consideration. The llocated as they beco	lable places for stud che Staatsprüfung (ate Law). A total of 10 ications from studen ving successfully cor remaining places wi me available.	lents of the degree p first state examination o places will be alloc ts of other subjects, npleted assessment ll be allocated by lot	orogramme on in law) as cated to stu- these places in the past t. A waiting	
Additio	nal information					
Worklo	ad					
60 h						
Teachi	ng cycle					
Referre	ed to in LPO I (examination reg	ulations for teaching-	degree programmes)			
Module appears in						
Bachel	or's degree (1 major, 1 minor) P	rivate Law (Minor, 20:	18)			
Bachel	or's degree (1 major, 1 minor) P	rivate Law (Minor, 20:	19)			
Master	's degree (1 major) Nanostructu	re Technology (2020)				
Master	's degree (1 major) Quantum Te	chnology (2021)				
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Module title					Abbreviation		
Electro	Electrochemical Energy Storage and Conversion 08-FU-EEW-152-m01						
Module coordinator Module offered by							
holder	of the (hair of Chemical Techno	logy of Material Syn-	Chair of Chemical T	echnology of Materi	al Synthesis	
thesis	thesis					ut Synthesis	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)			
5	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	undergraduate					
Conten	ts						
Chemis um and cal dou (Si, CIS	stry and d nickel ible lay 5, CIGS,	l application of: battery s metal hydride, sodium s er capacitors, redox-flow GaAs, organic and dye s	systems (aqueous and sulphur, sodium nicke batteries, fuel cell sy olar cell), thermoelec	d non-aqueous syste el chloride, lithium id ystems (AFC, PEMFC, tric devices.	ems such as lead, nic on accumulators), el DMFC, PAFC, SOFC),	ckel cadmi- ectrochemi- , solar cells	
Intende	ed lear	ning outcomes					
Studen that kn	its have owledg	e developed a knowledge e to research problems.	e of electrochemical e	nergy storage and co	onversion and are at	ole to apply	
Course	s (type	, number of weekly conta	act hours, language —	if other than Germa	n)		
V (2) +	P (1) +	E (1)					
Method	d of ass	essment (type, scope, la	anguage — if other tha	an German, examina	tion offered — if not	every seme-	
	comon	t and b) Vortestate /Nach	tostate (pre and past	a bolius)	ation talks approx 4	r minutor	
each, lo weighte Assess	og appi ed 7:3 ment o	ffered: Once a vear. sum	and assessment of pro-	actical assignments	(2 to 4 random exan	ninations),	
Langua	ige of a	ssessment: German and	/or English				
Allocat	ion of p	olaces					
Additio	onal inf	ormation					
Worklo	ad						
150 h			,				
Teachi	ng cycl	e					
		-					
Referre	d to in	IPOI (examination regu	lations for teaching-	legree programmes)			
Module	e annea	urs in					
Bachel	or' deg	ree (1 maior) Nanostructi	re Technology (2015)				
Master	's degr	ee (1 major) Physics (201	6)				
Master's degree (1 major) Nanostructure Technology (2016)							
Master's degree (1 major) Functional Materials (2016)							
Master's degree (1 major) Nanostructure Technology (2020)							
Master	Master's degree (1 major) Physics (2020)						
Master's degree (1 major) Physics International (2020)							
Master	's degr	ee (1 major) Quantum En	gineering (2020)	`			
Bachel	or' deg	ree (1 major) Nanostructu	ure Technology (2020)			
Bachel	or deg	ree (1 major) Quantum Te	ecnnology (2021)				
Master's wi	ith 1 majo	Quantum Technology (2021)	JMU Würzburg •	generated 30-Mär-2024 • ex	am. reg. da-	page 11 / 106	



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

Module title				Abbreviation	
Structure and Properties of Modern Materials: Experiments vs. Simulations					08-FU-MW-161-m01
Module	coord	inator		Module offered by	
degree tional N	progra Natrieri	mme coordinator Funktio als)	onswerkstoffe (Func-	Chair of Chemical T	echnology of Material Synthesis
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade		• • • •	
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Materia simulat	l prope ions.	erties of metals and cerar	nics: correlation of st	ructure/property rel	ations through experiments and
Intende	ed leari	ning outcomes			
Studen mance on. A sp perties.	ts gain cerami pecial f	an insight into the prope cs. They are introduced t ocus is on the relation be	erties of modern mate o measuring method etween the micro/nar	erials: aerospace alu s and calculation me noscopic structure of	minium alloys and high-perfor- ethods using numerical simulati- f materials and the resulting pro-
Courses	s (type	, number of weekly conta	ct hours, language —	· if other than Germa	n)
V (2) + 2	S (1)				
Method ster, inf	l of ass formati	s essment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
a) talk (nation i Assessi Langua	(approx in grou ment o ge of a	k. 30 minutes) or b) oral e ps of 2 (approx. 30 minut ffered: Once a year, winte ssessment: German and,	examination of one ca tes total) er semester /or English	andidate each (appro	ox. 20 minutes) or c) oral exami-
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
150 h					
Teachir	ng cycl	6			
		-			
Referre	d to in	IPOI (examination regu	lations for teaching-	legree programmes)	
Module	appea	irs in			
Master'	s degr	ee (1 major) Physics (201	6)		
Master'	s degr	ee (1 major) Nanostructur	e Technology (2016)		
Master'	s degr	ee (1 major) Functional M	aterials (2016)		
Master'	s degr	ee (1 major) Nanostructur	re Technology (2020)		
Waster'	s degre	ee (1 major) Physics (202	0) national (2020)		
Master	s degr	ee (1 major) Physics iller	gineering (2020)		
Master'	s degr	ee (1 major) Quantum Teo	:hnology (2021)		
	0.				

Module title				Abbreviation	
Sensor an	nd Actor Materials - Functiona	al Ceramics and Mag	netic Particles	08-FU-SAM-161-m01	
Module co	oordinator		Module offered by	<u> </u>	
degree pro tional Mat	ogramme coordinator Funktic trierials)	onswerkstoffe (Func-	Chair of Chemical T	echnology of Material Synthesis	
ECTS M	lethod of grading	Only after succ. com	pl. of module(s)		
5 nı	umerical grade		• • • •		
Duration	Module level	Other prerequisites			
1 semeste	er graduate				
Contents					
Fabricatio materials	on, effects and applications o and magnetostrictive materia	f sensory and actuato als. Electrorheologica	ory materials such as l and magnetorheolo	piezoelectrics, shape memory ogical fluids, magnetofluids.	
Intended	learning outcomes				
Students	have developed fundamenta	l knowledge in the ar	ea of sensory and ac	tuatory materials.	
Courses (t	type, number of weekly conta	ict hours, language —	· if other than Germa	n)	
V (2) + P (2	(2)	· · · · · · · · · · · · · · · · · · ·		-	
Method of ster, infor	f assessment (type, scope, la mation on whether module c	inguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
Assessme Language P: credital	ent offered: Once a year, sum of assessment: German and ble for bonus	/or English		,	
Allocation	1 of places				
Additiona	linformation				
Workload		-			
150 h					
Teaching	cycle	-			
Referred t	to in LPO I (examination regu	lations for teaching-o	legree programmes)		
Module ap	ppears in				
Master's o	degree (1 major) Physics (201	6)			
Master's o	Master's degree (1 major) Nanostructure Technology (2016)				
Master's C	Master's degree (1 major) Functional Materials (2016)				
Master's c	degree (1 major) Nanostructu	(2020)			
Master's c	degree (1 major) Physics (202	national (2020)			
Master's d	degree (1 major) Quantum En	gineering (2020)			
Master's d	degree (1 major) Quantum Te	chnology (2021)			
Master's o	degree (1 major) Quantum En	gineering (2024)			
Master's o	degree (1 major) Physics Inter	mational (2024)			

Module title				Abbreviation		
Ultrafa	Ultrafast spectroscopy and quantum-control 08-PCM4-161-m01					
Modul	e coordi	nator		Module offered by	<u> </u>	
locture	or of the g	eminar "Nanoskalige	Materialien"	Institute of Physica	l and Theoretical Ch	omistry
	Metho	d of grading				ennstry
	numeri	cal grade				
Durati			Other preveruisites			
	on stor	module level	Drior completion of	modulos os DCM12	and as DCMab racan	nmondod
Conter	nts	graduate		modules 00-r cm1a		intended.
This m	odule di	scusses advanced for	nics in ultrafast spectro	scopy and quantum	control. It focuses o	n ultrashort
laser p	ulses, ti	me-resolved laser spe	ctroscopy and coheren	t control.		
Intend	ed learn	ing outcomes				
Studer plain tl	nts are al he theor	ole to describe the get y of time-resolved lase	neration of ultrashort la er spectroscopy and na	aser pulses and to ch me experimental me	haracterise them. The thods. They can des	ey can ex- scribe the
princip	//				``	
Course	es (type,	number of weekly cor	tact hours, language –	- if other than Germa	in)	
S (2) + Module	Ú (1) e taught	in: German or English				
Metho	d of asse	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
ster, in	iformatic	n on whether module	can be chosen to earn	a bonus)		
a) writt	ten exam	ination (approx. 90 m	iinutes) or b) oral exam	ination of one candi	date each (approx. 2	20 minutes)
or c) ta	lik (appro	ox. 30 minutes) sossmont: Corman ar	d/or English			
Allocal	cion of p	aces				
Additio	onal info	rmation				
Worklo	oad					
150 h						
Teachi	ng cvcle					
	0.,					
Referre	ed to in L	.POI (examination re	gulations for teaching-	degree programmes)		
		-				
Modul	e annear	's in				
Master	r's dogro	e (1 major) Chemistry	(2016)			
Master	r's degre	e (1 major) Chemistry e (1 major) Mathemati	(2010)			
Master	r's degre	e (1 major) Physics (2)	16)			
Master	r's degre	e (1 major) Nanostruci	ture Technology (2016)			
Master	r's degre	e (1 major) Computati	onal Mathematics (201	6)		
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	Master's degree (1 major) Computational Mathematics (2019)					
Master	r's degre	e (1 major) Mathemati	cs (2019)			
Master	r's degre	e (1 major) Nanostruc	ture Technology (2020)			
Master	r's degre	e (1 major) Physics (20	020)			
Master	r's teach	ing degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (20	020)
Master's w	ith 1 major (Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 15 / 106

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) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Computational Mathematics (2024)

Module title					Abbreviation		
Artific	Artificial Intelligence 1 10-I=KI1-161-m01						
AA							
Module coordinator Mod				Module offered by	Module offered by		
holder	of the (Chair of Computer Scie	nce VI	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)			
5	nume	rical grade					
Durati	on	Module level	Other prerequisites	•			
1 seme	ester	graduate					
Contei	nts				1 11 11		
propos	gent age sitional	and predicate logic an	euristic search, constra d inference, knowledge	e representation.	, search with partial	information,	
Intend	ed lear	ning outcomes					
The stu search	udents and log	possess theoretical an gic and are able to ass	d practical knowledge ess possible applicatio	about artificial intelli ns.	gence in the area of	agents,	
Course	es (type	number of weekly cor	ntact hours, language –	- if other than Germa	in)		
V (2) +	Ü (2)	,,,,,			,		
Metho	d of ass	sessment (type, scope,	language — if other th	an German, examina	ition offered — if not	every seme-	
ster, ir	nformati	ion on whether module	can be chosen to earn	a bonus)		,	
writter	n exami	nation (approx. 60 to 1	20 minutes).				
If anno	ounced	by the lecturer at the b	eginning of the course,	the written examination	tion may be replace	d by an oral	
nrox 1	nation t	tes per candidate)	approx. 20 minutes) of	all oldt examination	i ili gloups ol 2 callu	luales (ap-	
Langu	age of a	ssessment: German ar	nd/or English				
credita	able for	bonus	, 0				
Alloca	tion of _l	olaces					
Additi	onal inf	ormation					
Focuse AT.SE.	es availa IS.HCI	able for students of the	e Master's programme l	nformatik (Compute	r Science, 120 ECTS	credits):	
Workl	oad						
150 h							
Teachi	ing cycl	e					
Referr	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)			
Modul	e appea	ars in					
Maste	r's degr	ee (1 major) Computer	Science (2016)				
Maste	r's degr	ee (1 major) Mathemat	ics (2016)				
Maste	r's degr	ee (1 major) Physics (2	016)				
Maste	r's degr	ee (1 major) Nanostruc	ture Technology (2016)				
Maste	r's degr	ee (1 major) Computati	onal Mathematics (201	.6)			
Maste	r's teacl	hing degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	016)	
Supple	ementai	ry course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2016)		
Maste	Master's degree (1 major) Computer Science (2017)						
Maste	r's doar	ee (1 major) Computer	onal Mathematics (201	O)			
Maste	r's degr	ee (1 major) Mathemat	ics (2010)	· <i>YI</i>			
		,,,					
Master's v	vith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	e generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- logie - 2021	page 17 / 106	

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)

Module title Abbreviation						
Analys	Analysis and Design of Programs 10-I=PA-161-m01					
Module coordinator			Module offered by			
holder	of the C	hair of Computer Scien	nce II	Institute of Comput	er Science	
ECTS	TS Method of grading Only after succ. compl. of module(s)					
5	numer	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conter	nts					
Progra	m analy	sis, model creation in	software engineering, J	program quality, test	of programs, proces	ss models.
Intend	ed learr	ning outcomes				
The stu quality	udents a '.	are able to analyse prog	grams, to use testing fr	ameworks and metri	cs as well as to judg	e program
Course	s (type	number of weekly con	tact hours language -	- if other than Germa	n)	
V(a)	$\ddot{\mathbf{u}}$	number of weekty con		If other than define		
V (2) +	0(2)					
Metho ster, in	d of ass formati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
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						
Allocat	tion of p	laces				
Additio	onal info	ormation				
Focuse SE,IS,E	es availa ES,GE	ble for students of the	Master's programme I	nformatik (Compute	Science, 120 ECTS o	credits):
Worklo	ad					
150 h						
Teechi						
Teacin	ing cycle	5				
Referre	ed to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
Modul	e appea	rs in				
Master	's degre	ee (1 major) Computer S	Science (2016)			
Master	's degre	ee (1 major) Mathemati	cs (2016)			
Master	's degre	ee (1 major) Physics (20	016)			
Master	's degre	ee (1 major) Nanostruct	ure Technology (2016)			
Master's degree (1 major) Computational Mathematics (2016)						
Master	's teach	ning degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (20	016)
Supple	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master	's degre	ee (1 major) Computer S	Science (2017)			
Master	's degre	ee (1 major) Computer !	Science (2018)			
Master	's degre	ee (1 major) Computati	onal Mathematics (201	9)		
Master	's degre	ee (1 major) Mathemati	cs (2019)			
Master	's degre	ee (1 major) Information	n Systems (2019)			
Master's w	vith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 19 / 106

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)

Module title					Abbreviation	
Advand	ced Pro	gramming		-	10-I-APR-172-m01	
Modul	o coord	inator		Modulo offered by	,	
Modul				Module offered by		
nolder	of the C	nair of Computer Scie		Institute of Comput	er Science	
ECIS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	Inume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	Its					
With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler pro-						
grams. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions						
and co	de dup	licates occur. In this le	cture, further knowledg	e is to be conveyed	on how to give progr	ams and co-
	ensidle : I	structure. Also, further	topics in the areas of s	ontware security and	parallel programmi	ng are dis-
Intend	ed learn	ning outcomes				
Studen		advanced programmi	ng paradigme conocial	ly cuited for chace a	aplications Difform	t pattarna ara
then in	nnleme	nted in multiple langus	ng paradigins especial	ly sulley for space a	andard metrics. In a	dition par-
allel nr	ocessir	nced in multiple langua	iced culminating in the	use of GPU architect	tures for extremely o	uick proces-
sing.	00000011					fullen proces
Course	s (type)	, number of weekly cor	itact hours, language –	- if other than Germa	n)	
V (2) +	Ü (2)					
Metho	d of ass	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	everv seme-
ster, in	formati	on on whether module	can be chosen to earn	a bonus)		,
written	examir	nation (approx. 60 to 1)	20 minutes).			
lf anno	unced l	by the lecturer at the b	eginning of the course,	the written examina	tion may be replace	d by an oral
examir	nation o	f one candidate each (approx. 20 minutes) or	an oral examination	in groups of 2 cand	idates (ap-
prox. 1	5 minut	es per candidate).				
Langua	age of a	ssessment: German ar	id/or English			
credita	ble for	bonus				
Allocat	tion of p	llaces				
Additio	onal info	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
Module	e appea	rs in				
Bachel	or' deg	ree (1 major) Computer	Science (2017)			
Bachel	Bachelor' degree (1 major) Computer Science (2019)					
Module	e studie	es (Bachelor) Computer	⁻ Science (2019)			
Master's degree (1 major) Nanostructure Technology (2020)						
Master's degree (1 major) Physics (2020)						
Master	's teacł	ning degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	020)
Supple	ementar	y course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2020)	
Bachel	or' deg	ree (1 major) Business	Information Systems (2	2020)		
Master's w	ith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex r (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 21 / 106

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Bachelor' degree (1 major) Computer Science und Sustainability (2021) Master's degree (1 major) Quantum Technology (2021) Bachelor' degree (1 major) Business Information Systems (2021) Bachelor' degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor' degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor' degree (1 major) Business Information Systems (2023) Bachelor' degree (1 major) Business Information Systems (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Bachelor' degree (1 major) Artificial Intelligence and Data Science (2023)

Module title Abbreviation						
Operat	ing Sys	stems			10-I-BS-191-m01	
Modul	e coord	inator		Module offered by	<u>I</u>	
holder	of the (Chair of Computer Scie	nce II	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			
1 seme	ester	undergraduate				
Conter	nts	5				
Introdu	uction to	o computer systems, d	evelopment of operatir	ig systems, architect	ure principles, interr	rupt proces-
sing in ry man	operat agemei	ing systems, processes nt, device and file man	and threads, CPU sch agement, operating sys	eduling, synchronisa stem virtualisation.	ition and communica	ation, memo-
Intend	Intended learning outcomes					
The stu	idents i	oossess knowledge an	d practical skills in bui	lding and using esse	ntial parts of operati	ing systems.
Course		number of weekly con	tact hours Janguage -	- if other than Germa		ing systems.
		, number of weekly con	liaci nours, language -		iii <i>)</i>	
V (2) + Moduli	U(2) ⊨tauorh	t in• English				
Motho		accment (type, ccepe	languago if other th	an Corman, ovamina	tion offered if not	00000 60000
ster, in	formati	on on whether module	can be chosen to earn	a bonus)		every serile-
written	exami	nation (approx. 60 to 1	20 minutes).			
lf anno	unced	by the lecturer at the b	eginning of the course,	the written examina	tion may be replace	d by an oral
examir	nation c	of one candidate each (approx. 20 minutes) oi	an oral examination	in groups of 2 cand	idates (ap-
prox. 1	5 minut	es per candidate).				
Langua	age of a ble for	ssessment: German ar honus	id/or English			
Allocat	tion of r	blaces				
Additio	onal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	6				
Referre	ed to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
			<u> </u>			
Modul	e appea	irs in				
Bachel	or' deg	ree (1 major) Computer	Science (2019)			
Master	's degr	ee (1 major) Nanostruct	ture Technology (2020)			
Master	's degr	ee (1 major) Physics (20	020)			
Bachel	or' deg	ree (1 major) Business	Information Systems (2	2020)		
Master	's degr	ee (1 major) Physics Int	ernational (2020)			
Master	's degr	ee (1 major) Quantum E	Ingineering (2020)			
Bachel	or' deg	ree (1 major) Aerospace	e Computer Science (20	020)		
Bachel	or' deg	ree (1 major) Computer	Science und Sustaina	bility (2021)		
Master	's degr	ee (1 major) Quantum 1	echnology (2021)	、 、		
Bachel	or' deg	ree (1 major) Business	Information Systems (2	2021)		
Bachel	or deg	ree (1 major) Artificial li	ntelligence and Data S	cience (2022)		
Master's w	ith 1 majo	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 23 / 106

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Bachelor' degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor' degree (1 major) Mathematics (2023) Bachelor' degree (1 major) Business Information Systems (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Bachelor' degree (1 major) Artificial Intelligence and Data Science (2024)

Module title			Abbreviation			
Discret	te Math	ematics			10-M=VDIM-161-mc	01
Modul	e coord	inator		Module offered by		
Doon	f Ctudi	nator	natical	Institute of Mathem		
					Idlics	
	numo	rical grado	Unity after succ. con	ipt. of module(s)		
5	Inume					
Duratio	on	module level	Uther prerequisites			
Conter		giauuale				
Advan	rod mot	hods and results in a s	elected field of discret	e mathematics (e. g	coding theony crypt	tography
graph	graph theory or combinatorics)					
Intend	ed learı	ning outcomes				
The stu	udent is	acquainted with advar	nced results in a select	ed topic in discrete r	nathematics.	
Course	s (type	, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (3) +	Ü (1)		_ · · · ·			
Modul	e taugh	t in: German and/or Eng	glish			
Metho	d of ass	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
		mination (approx. 6 a to	oo minutos, usuallu s	a bollus	mination of one can	didata aach
(annro	en exar x 15 mi	nutes) or c) oral examir	90 minutes, usually c	r(0Seff) of D) of all examples of 2 approx 10 m	initiation of one can inutes per candidate	aluale each
Assess	sment o	ffered: In the semester	in which the course is	offered and in the su	ibsequent semester	
Langua	age of a	ssessment: German or	English		·	
credita	ble for	bonus				
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	9				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Modul	e annea	rs in				
Master	's dogr	no III no (1 major) Mathematik	(2016)			
Master	's degr	e (1 major) Physics (20	u16)			
Master	's degr	ee (1 major) Nanostruct	ure Technology (2016)			
Master	's degr	ee (1 major) Economath	ematics (2016)			
Master	's degr	ee (1 major) Mathemati	cal Physics (2016)			
Master	's teacl	ning degree Gymnasium	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	016)
Supple	ementar	y course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2016)	-
Master	's degr	ee (1 major) Mathemati	cs (2019)			
Master	's degr	ee (1 major) Nanostruct	ure Technology (2020)			
Master	's degr	ee (1 major) Physics (20	20)			
Master	's teach	ning degree Gymnasium	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (20	020)
Supple	ementar	y course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2020)	
Master	's degr	ee (1 major) Mathemati	cal Physics (2020)			
Master's w	ith 1 majoi	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex r (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 25 / 106

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)

Module	title				Abbreviation
Advanc	ed Ana	lysis			10-M-VAN-152-m01
Module	e coord	inator		Module offered by	
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
7	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Continu	uation o	of analysis in several vari	ables, integration the	eorems.	
Intende	ed leari	ning outcomes			
The stu she is a	dent is able to	acquainted with advanc understand the construct	ed topics in analysis. tion of a complex mat	Taking the example thematical concept.	of the Lesbegue integral, he or
Course	s (type	number of weekly conta	ct hours, language —	if other than Germa	n)
V (4) +	Ü (2)	, <u>.</u>			,
Method ster, inf	d of ass formati	s essment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
a) writte (15 to 3 Langua credital	en exaı o minu ge of a ble for	mination (approx. 90 to 1 tes) or c) oral examinatio ssessment: German and/ bonus	80 minutes, usually c on in groups (groups c /or English	hosen) or b) oral ex of 2, 10 to 15 minutes	amination of one candidate each s per candidate)
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
210 h					
Teachir	ng cycl	e			
Referre	d to in	IPOL (examination regu	lations for teaching	legree programmes)	
Referre					
Module	e appea	urs in	- ()		
Bachel	or deg	ree (1 major) Mathematic	S (2015)		
Bachol	or dog	ree (1 major) Mathematic	al Physics (2015) nal Mathematics (201		
Bachel	or' dag	ree (1 major) Computation	al Physics (2016)	-5/	
Master'	's dear	ee (1 major) Physics (201	6)		
Master'	's degr	ee (1 major) Nanostructur	e Technology (2016)		
Master'	's degr	ee (1 major) Nanostructur	re Technology (2020)		
Master'	's degr	ee (1 major) Physics (202	0)		
Master'	's degr	ee (1 major) Physics Inter	national (2020)		
Master'	's degr	ee (1 major) Quantum Eng	gineering (2020)		
Master'	's degr	ee (1 major) Quantum Teo	hnology (2021)		
Bachelo	or' deg	ree (1 major) Mathematic	s (2023)		

Module title			Abbreviation		
Selected Topics of Theoretical Solid State Physics				11-AKTF-201-m01	
Module coord	linator		Module offered by		
Managing Dir and Astrophy	ector of the Institute of sics	Theoretical Physics	Faculty of Physics and 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					
In this lecture, selected topics of condensed matter theory are addressed. We intend to present new develop- ments to bring the students in touch with actual research topics. Possible subjects are many-body localization and dynamic quantum matter.					
Intended lear	ning outcomes				
The students theoretical po a smooth cro	learn how to describe o bint of view. This happe ssover of these student	ondensed matter systens ns on the basis of anal s to the next step of be	ems in presence of di ytical and numerical coming a researcher	isorder and interacti methods. Therefore	ons from a , we envisage
Courses (type	e, number of weekly cor	itact hours, language –	- if other than Germa	n)	
V (3) + R (1) Module taugł	nt in: German or English				
Method of as ster, informat	sessment (type, scope, ion on whether module	language — if other the can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
If a written ex stead take th of assessmer nation date a Language of a	ges) or 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				
Allocation of	places				
	placeo				
Additional int	Formation				
Additional in					
Workload					
180 h					
Teaching cyc	le				
Referred to in	LPOI (examination re	gulations for teaching-	degree programmes)		
Module appears in					
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 with 1 majo	or Quantum Technology (2021)	JMU Würzburg ● ta record Maste	generated 30-Mär-2024 • ex	am. reg. da- ogie - 2021	page 28 / 106



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

Module	e title				Abbreviation	
Astropl	hysics				11-AP-152-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	ing Dire trophys	ector of the Institute of ics	Theoretical Physics	Faculty of Physics a	ind Astronomy	
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	;		
1 seme	ster	undergraduate				
Conten	ts					
History of astronomy, coordinates and time measurement, the Solar System, exoplanets, astronomical scales, telescopes and detectors, stellar structure and atmospheres, stellar evolution and end stages, interstellar medi- um, molecular clouds, structure of the milky way, the local universe, the expanding universe, galaxies, active ga- lactic nuclei, large-scale structures, cosmology.						
Intende	ed leari	ning outcomes				
The stu physica ons. Th laxies.	dents a al obse ey are	are familiar with the mo rvations and evaluatior familiar with the physic	odern world view of Ast ns. They are able to use and development of	rophysics. They know e these methods to p the main astrophysi	w methods and tools lan and analyse owr cal objects such as s	s for astro- n observati- stars and ga-
Course	s (type	, number of weekly con	tact hours, language –	- if other than Germa	ın)	
V (2) + Module	R (2) e taugh	t in: German or English				
Methoo ster, inf	l of ass formati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	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.						
Allocat	ion of p	olaces				
 Additio	nal inf	ormation				
Worklo						
180 h						
Teechir		•				
		e				
Referre	d to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
§ 22 Nr. 1 h) § 22 Nr. 2 f) § 22 Nr. 3 f)						
Module	e appea	in in				
Bachelo Bachelo Bachelo	or' deg or' deg or' deg	ree (1 major) Physics (2 ree (1 major) Mathemat ree (1 major) Acrospace	015) ical Physics (2015)	215)		
Mactoria	th a main				am rog da	
master S WI	ur i majoi		ta record Maste	er (120 ECTS) Quantentechnol	ogie - 2021	page 30 / 106

UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) First state examination for the teaching degree Grundschule Physics (2015) First state examination for the teaching degree Grundschule Didactics in Physics (Primary School) (2015) First state examination for the teaching degree Realschule Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Sonderpädagogik Didactics in Physics (Middle School) (2015) First state examination for the teaching degree Mittelschule Physics (2015) First state examination for the teaching degree Mittelschule Didactics in Physics (Middle School) (2015) Bachelor' degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Bachelor' degree (1 major) Aerospace Computer Science (2017) First state examination for the teaching degree Grundschule Physics (2018) First state examination for the teaching degree Grundschule Didactics in Physics (Primary School) (2018) First state examination for the teaching degree Realschule Physics (2018) First state examination for the teaching degree Gymnasium Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018) First state examination for the teaching degree Sonderpädagogik Didactics in Physics (Middle School) (2018) First state examination for the teaching degree Mittelschule Didactics in Physics (Middle School) (2018) Master's degree (1 major) Nanostructure Technology (2020) Bachelor' degree (1 major) Physics (2020) Bachelor' degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) Bachelor' degree (1 major) Aerospace Computer Science (2020) First state examination for the teaching degree Grundschule Didactics in Physics (Primary School) (2020) First state examination for the teaching degree Grundschule Physics (2020) First state examination for the teaching degree Gymnasium Physics (2020) First state examination for the teaching degree Realschule Physics (2020) First state examination for the teaching degree Sonderpädagogik Didactics in Physics (Middle School) (2020) First state examination for the teaching degree Mittelschule Didactics in Physics (Middle School) (2020) First state examination for the teaching degree Mittelschule Physics (2020) Master's degree (1 major) Quantum Technology (2021) exchange program Physics (2023) Bachelor' degree (1 major) Mathematical Physics (2024)

Module title				Abbreviation			
Method	ds of O	bservational Astronomy			11-ASM-161-m01		
Module	e coord	inator		Module offered by			
Managi and Ast	ing Dire trophys	ector of the Institute of Th sics	neoretical Physics	Faculty of Physics and Astronomy			
ECTS	Methe	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						
Methoo from ra	ls of ol dio, op	oservational astronomy a otical, X-ray and gamma-r	cross the electromag ay telescopes.	netic spectrum. Eval	uation of observatio	nal data	
Intende	ed lear	ning outcomes					
Overvie dio, opt ability t	Overview of the methods used in observational astronomy in various parts of the electromagnetic spectrum (ra- dio, optical, X-ray and gamma-ray energies). Knowledge of principles and applications of these methods and ability to conduct astronomical observations.						
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	n)		
V (3) + Module	R (1) e taugh	t in: German or English					
Methoo ster, in	l of as formati	s essment (type, scope, la ion on whether module c	anguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-	
or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester							
Allocat	ion of	olaces					
Additio	nal inf	ormation					
Additio		ormation					
WOFKIO	ad						
180 h							
Teachir	ng cycl	e					
Referre	d to in	LPOI (examination regu	llations for teaching-o	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)				
Master	's degr	ee (1 major) Nanostructu	re Technology (2016)				
Master	's degr	ee (1 major) Computatior	nal Mathematics (201	6)			
Master	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supple	menta	ry course MINT Teacher E	ducation PLUS, Elite	Network Bavaria (ENI	B) (2016)		
Master	's degr	ee (1 major) Computatior	al Mathematics (201	9)			
Master's wi	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa r (120 ECTS) Quantentechnolo	am. reg. da- ogie - 2021	page 32 / 106	

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)

Module title				Abbreviation		
Introdu	iction t	o Space Physics			11-ASP-161-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	ing Dire trophys	ector of the Institute of Th sics	neoretical Physics	Faculty of Physics and Astronomy		
ECTS Method of grading Only after succ.			Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
1. Oven 2. Dyna 3. Elem 4. The s 5. Acce 6. Instr	 Overview Dynamics of charged particles in magnetic and electric fields Elements of space physics The sun and heliosphere Acceleration and transport of energetic particles in the heliosphere Instruments to measure energetic particles in extraterrestrial space 					
Intende	ed lear	ning outcomes				
The stu mics of and coi	dents a charge rrespor	acquire basic knowledge ed particles in space and nding measuring method	of Space Physics, in the heliosphere. The s.	particular regarding y know relevant para	the characterisation ameters and theoreti	of the dyna- ical concepts
Course	s (type	, number of weekly conta	ict hours, language –	- if other than Germa	n)	
V (3) + Module	R (1) e taugh	t in: German or English				
Methoo ster, in	d of ass formati	essment (type, scope, la on on whether module c	inguage — if other th an be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written or oral pages) If a writ stead ta of asse nation Assess Langua	written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester					30 minutes) rox. 8 to 10 nt may in- If the method riginal exami-
Allocat	ion of r	olaces	0.1			
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)		
Module	e appea	urs in				
Master's degree (1 major) Mathematics (2016)						
Master	Master's degree (1 major) Physics (2016)					
Master	's degr	ee (1 major) Nanostructu	re Technology (2016)			
Master's wi	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa r (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 34 / 106

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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) Computational Mathematics (2024)

Module title				Abbreviation		
Image	and Sig	nal Processing in Phy	sics		11-BSV-161-m01	
Module	e coord	inator		Module offered by	~ ·	
Manag	ing Dire	ector of the Institute of	Applied 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	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Periodi	c and a	periodic signals; princ	iples of discreet and ex	kact Fourier transform	nation; principles of	digital signal
and im	age pro	cessing; discretisatior	of signals/sampling t	heorem (Shannon); ł	nomogeneous and li	near filters,
convol	ution pi	oduct; tapering function	ons and interpolation o	of images; the Parsiva	al theorem, correlation	on and ener-
transfo	rmation	non, statistical signats, 1.		s, stationary signats;	, tomography: hanke	
Intende	ed learr	ning outcomes				
The stu les of in ferent r	idents ł mage p nethod	nave advanced knowle rocessing and are fami s and to implement the	dge of digital image an liar with different meth em, especially in the fig	d signal processing. ods of signal proces eld of tomography.	They know the phys sing. They are able t	ical princip- o explain dif-
Course	s (type	, number of weekly con	tact hours, language -	- if other than Germa	ın)	
V (2) +	Ü (2)	,			·	
Module	e taugh	t in: German or English				
Metho ster, in	d of ass formati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written	examir	nation (approx. 90 to 1	20 minutes) or oral exa	mination of one can	didate each (approx	. 30 minutes)
or oral	examin	ation in groups (group	s of 2, approx. 30 minu	ites per candidate) o	r project report (app	rox. 8 to 10
pages)	or pres	entation/talk (approx.	30 minutes).			
ii a wiii stead t	ake the	form of an oral exami	as method of assessme	ent, this may be chai e each or an oral exa	nged and assessment	If the method
ofasse	ssment	is changed, the lectur	er must inform student	ts about this by four	weeks prior to the o	riginal exami-
nation	date at	the latest.		,		0
Assess	ment o	ffered: In the semester	in which the course is	offered and in the su	ubsequent semester	
Langua	ige of a	ssessment: German ar	d/or English			
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	9				
Referre	ed to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
-						
Module	e appea	rs in				
Master	's degre	ee (1 maior) Mathemati	cs (2016)			
Master	Master's degree (1 major) Physics (2016)					
Master's degree (1 major) Nanostructure Technology (2016)						
Master	's degre	ee (1 major) Computati	onal Mathematics (201	6)		
Master	's degre	ee (1 major) Functional	Materials (2016)			
Master's w	ith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exer (120 ECTS) Ouantentechnol	am. reg. da- ogie - 2021	page 36 / 106
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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) 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) Computational Mathematics (2024)

Module	title				Abbreviation
Advanc	ed Top	ics in Solid State Physics	5		11-CSFM-161-m01
Module	e coord	inator		Module offered by	
Managi and Ast	ing Dire trophys	ector of the Institute of Th sics	eoretical 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	n	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
This mo vered in not incl	odule w n any o luded i	vill enable the lecturers o f the other modules. The n the regular curriculum.	f Condensed Matter I se topics may relate (Physics to teach adva either to recent resea	anced courses on topics not co- arch developments or to subjects
Intende	ed lear	ning outcomes			
The stu and acc	dents a quire ir	advance their knowledge isights into the connectio	and understanding ons between research	of an advanced topic 1 and teaching.	of Condensed Matter Physics
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	in)
V (3) +	R (1)				
Methoo ster, inf	l of ass formati	sessment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
If a writ stead ta of asse nation Langua	to 10 p ten exa ake the ssmen date at ge of a	ages) or e) presentation, amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: German and,	talk (approx. 30 min method of assessmo tion of one candidate must inform student /or English	utes). ent, this may be char e each or an oral exa s about this by four	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocal		Jaces			
Additio	natini	ormation			
Worklo	ad				
180 h					
Teachir	ıg cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
Module	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) Module studies (Master) Physics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020)				ork Bavaria (ENB) (2016) B) (2016)	
Master	's teacl	ning degree Gymnasium I	MINT Teacher Educat	ion PLUS, Elite Netwo	ork 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)

Advanced Topics in Quantum Technology 11-CSNM-212-mo1 Module coordinator Module offered by Managing Director of the institute of Theoretical Physics and Astrophysics Faculty of Physics and Astronomy and Astrophysics 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. Contents This module allows lecturers of the quantum technology study programme to give lectures on advanced topics that can not be covered by any other module. These lectures may either reflect new developments in research or deal with topics that are not included in the regular teaching cycle. Intended learning outcomes The students deepen their knowledge and understanding of an advanced topic in quantum technology, thereby gaining insights into the interface between research and teaching. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (3) Module taight in: German or English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information in groups (groups of 2, approx. 30 minutes) or oral examination of a noral examination of a noral examination of a noral examination of a seessment, 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.	Module	title				Abbreviation
Module correlation Module offered by Managing Director of the institute of Theoretical Physics Faculty of Physics and Astronomy ECTS Method Stronomysics Faculty of Physics and Astronomy ECTS Method Stronomysics Only after succ. compl. of module(s) ECTS Method level Other prerequisites Duration Module level Other prerequisites Duration Module level Ophymathony of the maximization committee required. Contents This module allows lecturers of the quantum technology study programme to give lectures on advanced topics that can not be covered by any other module. These lectures may either reflect new developments in research or deal with topics that are not included in the regular teaching cycle. Internet learning outper developments in technology study programme to give lectures on advanced topics that can not be covered by any other module. These lectures may either reflect new developments in research or deal with topics that are not included in the regular teaching. Internet development of weekly contact hours, language — if other than German) Y (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) written examination (approx. yo to 120 minutes) Iso and assessment, this may be changed and assessment may in stead take the f	Advanc	ed Top	ics in Quantum Technolo	gy		11-CSNM-212-m01
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Master's degree (1 major) Quantum Technology (2021)	Module	appea	irs in			
Madula studios (Master) Quantum Tashnalam (2004)	Master'	s degr	ee (1 major) Quantum Teo	hnology (2021)		
module sludies (master) Quantum Technology (2021)	Module	studie	es (Master) Quantum Tecl	nnology (2021)		

Module	e title				Abbreviation
Advanc	ed Top	ics in Physics			11-CSPM-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. com	pl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
This mo module lar curr	odule w es. Thes iculum	vill enable lecturers of Ph se topics may relate eithe	ysics to teach advance er to recent research o	ced courses on topic developments or to s	s not covered in any of the other subjects not included in the regu-
Intende	ed lear	ning outcomes			
The stu acquire	idents a e insigh	advance their knowledge ts into the connections b	and understanding on etween research and	of an advanced topic I teaching.	of nanostructure technology and
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)
V (3) +	R (1)				
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Allocat	ion of p	olaces			
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Additio	onal inf	ormation			
Worklo	ad				
180 h					
Teachi	ng cycl	e			
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module	e appea	urs in			
Master	's degr	ee (1 major) Nanostructur	re Technology (2016)		
Master	's degr	ee (1 major) Nanostructur	re Technology (2020)		
Master	's degr	ee (1 major) Quantum Teo	chnology (2021)		
Module	e studie	es (Master) Quantum Tecl	nnology (2021)		

Module	e title				Abbreviation
Electro	on and lo	on Microscopy			11-EIM-211-m01
Module	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	plied 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		
1 seme	ster	graduate			
Conten	its	1		e 1 1 1 1 1	
Theore trons a ced co	tical Fo nd chai ntrast n	undations. Electron and i rged particles, detectors, nechanisms: EBSD, EELS,	ion sources, optics of measurement princi , EDS, cathodolumine	f charged particles, i ples: SEM, STEM, TE escence.	nteraction of matter with elec- M, sample preparation, advan-
Intend	ed learr	ning outcomes			
The stu and ins electro	ident ha strumer n micro	as specific and immersec Ital basics and principles Iscopy and their applicati	d knowledge in electr s of detectors and cor ions. He/she knows o	on and ion microsco ntrast mechanisms. I ongoing developmer	py. He/she knows the theoretical He/she knows different modi of hts in this field.
Course	s (type,	, number of weekly conta	ct hours, language –	- if other than Germa	in)
V (3) + Module	R (1) e taugh	t in: German or English			
Metho ster, in	d of ass formati	essment (type, scope, la on on whether module ca	inguage — if other than an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
nutes) prox. 8 If a wri stead t of asse nation Langua Prüfun	or c) or to 10 p tten exa take the essment date at age of a gsturnu	al examination in groups bages) or e) presentation/ amination was chosen as form of an oral examina- t is changed, the lecturer the latest. ssessment: German and/ is: im Semester der LV un	(groups of 2, approx /talk (approx. 30 min method of assessme tion of one candidate must inform student /or English nd im Folgesemester	. 30 minutes per can utes). ent, this may be chan e each or an oral exa is about this by four t	ndidate) or d) project report (ap- nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
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180 h					
Teachi	ng cycl	e			
Teachi	ng cycle	e: annually, after announ	cement		
Referre	ed to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
Module	e appea	irs in			
Master Master Master Master	's degre 's degre 's degre 's degre	ee (1 major) Nanostructur ee (1 major) Physics (202 ee (1 major) Quantum Tec ee (1 major) Functional M	re Technology (2020) o) chnology (2021) aterials (2022)		
excnar	ige prog	gram Physics (2023)			

Module title				Abbreviation
Current Topic	s in Quantum Technology	/		11-EXN5-212-m01
Module coord	linator		Module offered by	
chairperson o	of examination committee		Faculty of Physics a	nd Astronomy
ECTS Meth	od of grading	Only after succ. com	pl. of module(s)	
5 nume	erical grade			
Duration	Module level	Other prerequisites		
1 semester	graduate	Approval from exam	ination committee re	equired.
Contents				
Current topics university or s	s in experimental or theor study abroad.	etical physics. Credit	ed academic achiev	ements, e.g. in case of change of
Intended lear	ning outcomes			
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V (2) + R (2) Module taugi	nt in: German or English			
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written exami or oral exami pages) or pre If a written ex stead take th of assessmer nation date a Language of a	nation (approx. 90 to 120 nation in groups (groups (sentation/talk (approx. 30 amination was chosen as e form of an oral examina it is changed, the lecturer t the latest. assessment: German and	 minutes) or oral example minutes) or oral example of 2, approx. 30 minutes or minutes). method of assessment tion of one candidate must inform student /or English 	mination of one cano tes per candidate) o ent, this may be chan each or an oral exa s about this by four	didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
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Additional in	formation			
Workload				
150 h				
Teaching cycle				
Referred to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Module appe	ars in			
Master's deg	ree (1 major) Quantum Teo	chnology (2021)		
Module studi	es (Master) Quantum Tec	hnology (2021)		

Module	e title				Abbreviation
Current	t Topics	s in Quantum Technology	/		11-EXN6-212-m01
Module	e coord	inator		Module offered by	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
Current univers	t topics sity or s	in experimental or theor tudy abroad.	etical physics. Credit	ed academic achiev	ements, e.g. in case of change of
Intend	ed lear	ning outcomes			
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Course	s (type	, number of weekly conta	ct nours, language –	I other than Germa	(II)
V (3) + Module	к (1) e taugh	t in: German or English			
Metho ster, in	d of ass formati	Sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
written or oral pages) If a writ stead t of asse nation Langua	examin examin or pres tten exa ake the essmen date at ige of a	nation (approx. 90 to 120 nation in groups (groups of sentation/talk (approx. 30 amination was chosen as a form of an oral examina t is changed, the lecturer the latest. ssessment: German and	or oral exa of 2, approx. 30 minu o minutes). method of assessme tion of one candidate must inform student /or English	mination of one cand tes per candidate) o ent, this may be chai e each or an oral exa s about this by four	didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocat	ion of r	olaces	J		
Additio	onal inf	ormation			
Worklo	ad				
180 h					
Teachi	Teaching cycle				
Referre	ed to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
Module	e appea	ars in			
Master	's degr	ee (1 major) Quantum Teo	chnology (2021)		
Module	e studie	es (Master) Quantum Tec	hnology (2021)		

Module title				Abbreviation	
Current Top	ics in Quantum Technology	/		11-EXN6A-212-m01	
Module coo	rdinator		Module offered by		
chairperson	of examination committee		Faculty of Physics a	nd Astronomy	
ECTS Met	hod of grading	Only after succ. com	pl. of module(s)		
6 nun	nerical grade				
Duration	Module level	Other prerequisites			
1 semester	graduate	Approval from exam	ination committee re	equired.	
Contents					
Current topi university o	cs in experimental or theor r study abroad.	etical physics. Credit	ed academic achiev	ements, e.g. in case of change of	
Intended le	arning outcomes				
The student physics on rent field in knowledge.	posseses advanced knowl Master's level in the study p physics and insight into th He/She is able to classify a	edge meeting the rec programme Quantum e measuring and calc and to link the learnt.	quirements of a mod Technology. He/She culating methods wh He/She knows abou	ule in theoretical or experimental e commands knowledge in a cur- ich are necessary to acquire this ut fields of application.	
Courses (ty	pe, number of weekly conta	ct hours, language –	- if other than Germa	n)	
V (3) + R (1) Module tau;	ght in: German or English				
Method of a ster, inform	ssessment (type, scope, la ation on whether module c	inguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
written exar or oral exan pages) or pi If a written e stead take t of assessme nation date Language o	nination (approx. 90 to 120 nination in groups (groups of resentation/talk (approx. 30 examination was chosen as he form of an oral examina ent is changed, the lecturer at the latest. f assessment: German and	o minutes) or oral exa of 2, approx. 30 minu o minutes). method of assessme tion of one candidate must inform student /or English	mination of one cand tes per candidate) o ent, this may be char e each or an oral exa s about this by four	didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-	
Allocation	fplaces				
Additional i	nformation				
Workload					
180 h					
Teaching cy	Teaching cycle				
Referred to	in LPO I (examination regu	lations for teaching-o	degree programmes)		
Module app	ears in				
Master's de	gree (1 major) Quantum Teo	chnology (2021)			
Module stu	dies (Master) Quantum Tec	hnology (2021)			

Current Topics in Quantum Technology 11:EXN7-212:m01 Module coordinator Module offered by Chairperson of examination committee Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 7 numerical grade Duration Module tevel Other prerequisites 1 semester graduate Approval from examination committee required. 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 student posseses advanced knowledge meeting the requirements of a module in theoretical or experimental physics on Master's level in the study programme Quantum Technology. He/She commands knowledge in a current field in physics and insight into the measuring and calculating methods which are necessary to acquire this knowledge. He/She is able to classify and to link the learnt. He/She knows about fields of application. Coursets (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taget 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) V(3) + R (1) Module taget (1) Garaata (1)	Module	e title				Abbreviation
Module cover inter Module offered by chairperson of examination committee Faculty of Physics and Astronomy ETS Meetod of grading Only after succ. compl. of module(s) 7 numerical grade Duration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Contents Contents The student possesses advanced knowledge meeting the requirements of a module in theoretical or experimental a physics on Master's level in the study programme Quantum Technology. He/She commands knowledge in a current field in physics and insight into the measuring and calculating methods which are necessary to acquire this knowledge. He/She is able to classify and to link the learnt. He/She knows about fields of application. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (3) Module taught in: German or English Method of assessment (type, scope, language — if other than German, examination offered – if not every semester, information in groups of to za primutes) stead take the form of a no al examination of one candidate each (approx. 30 minutes) If a written examination (approx. 90 to 120 minutes) Method of assessment (type, scope, language – if other than German) v (3) e 13 y (3) e 2, approx. 30 minutes)	Current	t Topics	s in Quantum Technology	/		11-EXN7-212-m01
chairperson of examination committee Faculty of Physics and Astronomy ECTS Method of griding Only after succ. compl. of module(s) 7 numerical grade Duration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Contemts Contemt topics in experimental or theoretical physics. Credited academic achievements, e.g. in case of change of university or study abroad. Intended learning outcomes Intended learning outcomes The student possess advanced knowledge meeting the requirements of a module in theoretical or experimental physics on Master's level in the study programme Quantum Technology. He/She commands knowledge in a current field in physics and insight into the measuring and calculating methods which are necessary to acquire this knowledge. He/She is able to classify and to link the learnt. He/She knows about fields of application. 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) V (3) + R (1) Module can be chosen to earn a bonus written examination in groups (groups of 2, approx, 30 minutes) or oral examination of one candidate each (approx, 30 minutes) or ral examination in groups, groups of 2, approx, 30 minutes por presentation/falk (approx, 30 minutes). If a written examination	Module	e coord	inator		Module offered by	
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7 numerical grade - Duration Module level Other prerequisites 1 semester graduate Approval from examination committee required. Contents	ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
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 lear-ing outcomes The student posseses advanced knowledge meeting the requirements of a module in theoretical or experimental physics on Master's level in the study programme Quantum Technology. He/She commands knowledge in a current field in physics and insight into the measuring and calculating methods which are necessary to acquire this knowledge. He/She is able to classify and to link the learnt. He/She knows about fields of application. 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 semester, information on whether module can be chosen to earn a bonus) written examination in groups (groups of 2, approx. 30 minutes) or oral examination in groups. If the method of assessment (type, scope, language the 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 Aldicor	7	nume	rical grade			
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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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places Additional information Workload 210 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)	Module	e taugh	t in: German or English			
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places Additional information Workload 210 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)	Methoo ster, in	l of ass formati	sessment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
Allocation of places Additional information Workload 210 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)	written or oral pages) If a writ stead ta of asse nation Langua	examin examin or pres ten exa ake the ssmen date at ge of a	nation (approx. 90 to 120 nation in groups (groups of sentation/talk (approx. 30 amination was chosen as e form of an oral examina t is changed, the lecturer the latest. ssessment: German and,	minutes) or oral examples of 2, approx. 30 minutes). method of assessme tion of one candidate must inform student /or English	mination of one cano tes per candidate) o ent, this may be char each or an oral exa s about this by four y	didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
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210 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)	Worklo	ad				
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Module appears in Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)						
Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)	Module	e appea	irs in			
Module studies (Master) Quantum Technology (2021)	Master	's degr	ee (1 major) Quantum Teo	hnology (2021)		
	Module	e studie	es (Master) Quantum Tecl	1nology (2021)		

Module	e title				Abbreviation
Current	t Topic	s in Quantum Technology	/		11-EXN8-212-m01
Module	e coord	inator		Module offered by	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee r	equired.
Conten	ts				
Current univers	t topics sity or s	in experimental or theor tudy abroad.	etical physics. Credit	ed academic achiev	ements, e.g. in case of change of
Intende	ed lear	ning outcomes			
The stu physics rent fie knowle	Ident p s on Ma Id in pl Idge. Ho	osseses advanced knowl aster's level in the study p nysics and insight into th e/She is able to classify a	edge meeting the rec programme Quantum e measuring and calc and to link the learnt.	uirements of a mod Technology. He/She sulating methods wh He/She knows abou	ule in theoretical or experimental e commands knowledge in a cur- ich are necessary to acquire this ut fields of application.
Course	s (type	, number of weekly conta	ict hours, language –	- if other than Germa	in)
V (4) + Module	R (2) e taugh	t in: German or English			
Metho ster, in	d of ass formati	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
written or oral pages) If a writ stead t of asse nation Langua	examin examin or pres tten exa ake the essmen date at age of a	nation (approx. 90 to 120 nation in groups (groups of sentation/talk (approx. 30 amination was chosen as a form of an oral examina t is changed, the lecturer the latest. ssessment: German and	o minutes) or oral exa of 2, approx. 30 minu o minutes). 6 method of assessme tion of one candidate 7 must inform student /or English	mination of one can tes per candidate) o ent, this may be chan e each or an oral exa s about this by four	didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocat	ion of r	places	0,0		
Additio	onal inf	ormation			
Worklo	ad				
240 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
Module	e appea	ars in			
Master	's degr	ee (1 major) Quantum Teo	chnology (2021)		
Module	e studie	es (Master) Quantum Tec	hnology (2021)		

Module	e title				Abbreviation
Non-te	chnical	Minor Subject			11-EXNT6-161-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. com	pl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
Non-te	chnical	minor. Crediting for acad	lemic achievements,	e.g. from university	change or study abroad
Intende	ed lear	ning outcomes			
The stu dule in	dents l the fie	have advanced competer ld of a non-technical min	ncies on the Master's or (mathematics, che	level which correspondent corr	ond to the requirements of a mo- law, business sciences).
Course	s (type	, number of weekly conta	ct hours, language —	if other than Germa	n)
V (3) +	R (1)				
Metho ster, in	d of ass formati	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
or oral pages) If a writ stead t of asse nation Langua	examin or pres tten exa ake the ssmen date at ge of a	nation in groups (groups of sentation/talk (approx. 30 amination was chosen as e form of an oral examina t is changed, the lecturer the latest. ssessment: German and,	of 2, approx. 30 minuto minutes). method of assessme tion of one candidate must inform student /or English	tes per candidate) o ent, this may be chan e each or an oral exa s about this by four	r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
180 h					
Teachi	ng cycl	e			
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module	e appea	ars in			
Master	's degr	ee (1 major) Nanostructui	e Technology (2016)		
Master	's degr	ee (1 major) Nanostructui	re Technology (2020)		
Master	's degr	ee (1 major) Quantum Teo	hnology (2021)		

Module	e title				Abbreviation
Current	t Topic	s in Physik			11-EXP5-161-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. com	npl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
Current univers	t topics ity or s	in Experimental or Theor tudy abroad.	etical Physics. Credit	ed academic achiev	ements, e.g. in case of change of
Intend	ed lear	ning outcomes			
The stu Theore subdis knowle	idents tical Ph cipline edge. Th	have advanced competer nysics of the Master's pro of Physics and understar ney are able to classify th	ncies corresponding t gramme of Nanostruc nd the measuring and e subject-specific col	o the requirements o cture Technology. Th I/or calculation meth ntexts and know the	of a module of Experimental or ey have knowledge of a current nods necessary to acquire this application areas.
Course	s (type	, number of weekly conta	ct hours, language –	· if other than Germa	n)
V (2) +	R (2)	· · · ·			
Method ster, in written or oral pages) If a writ stead t of asse nation Langua Allocat	d of ass formati examin examin or pres tten exa ake the essmen date at age of a ion of j	sessment (type, scope, la ion on whether module ca nation (approx. 90 to 120 nation in groups (groups of sentation/talk (approx. 30 amination was chosen as a form of an oral examina t is changed, the lecturer the latest. ssessment: German and, places	nguage — if other tha an be chosen to earn minutes) or oral exa of 2, approx. 30 minu o minutes). method of assessme tion of one candidate must inform student /or English	an German, examina a bonus) mination of one cano tes per candidate) o ent, this may be char e each or an oral exam s about this by four y	tion offered — if not every seme- didate each (approx. 30 minutes) r project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Additio	onal inf	ormation			
Worklo	ad				
150 h					
Teachi	ng cycl	e			
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module	e appea	ars in			
Master Master Master Module	's degr 's degr 's degr e studie	ee (1 major) Nanostructur ee (1 major) Nanostructur ee (1 major) Quantum Tec es (Master) Quantum Tecl	re Technology (2016) re Technology (2020) chnology (2021) nnology (2021)		

Modul	e title				Abbreviation	
Curren	t Topic	s in Physik			11-EXP6-161-m01	
Modul	e coord	inator		Module offered by	<u> </u>	
chairne	erson o	f examination committ	ee	Faculty of Physics a	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	i		
1 seme	ester	graduate	Approval from exam	nination committee r	equired.	
Conter	nts		I * *			
Curren univers	t topics sity or s	in experimental or the tudy abroad.	eoretical physics. Credit	ted academic achiev	ements, e.g. in case	of change of
Intend	ed lear	ning outcomes				
The stu Theore subdis knowle	udents tical Ph cipline edge. Th	have advanced compenysics of the Master's profile of the Master's profile of Physics and unders hey are able to classify	tencies corresponding programme of Nanostru tand the measuring an the subject-specific co	to the requirements cture Technology. Th d/or calculation met ntexts and know the	of a module of Expen ley have knowledge hods necessary to ac application areas.	'imental or of a current cquire this
Course	s (type	, number of weekly cor	ntact hours, language –	– if other than Germa	an)	
V (3) +	R (1)					
Metho ster, in	d of ass formati	sessment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	ition offered — if not	every seme-
If a wri stead t of asse nation Langua	tten exa ake the essmen date at age of a	amination was chosen form of an oral exami t is changed, the lectu the latest. ssessment: German an	as method of assessm nation of one candidate rer must inform studen	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	nt may in- If the method riginal exami-
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h	_					
Teachi	ng cvcl	e				
	0.7	-				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
			34.44.010 101 1040111.3			
Modul	e appea	urs in				
Master	's degr	ee (1 maior) Physics (2	016)			
Master	's degr	ee (1 major) Nanostruc	ture Technology (2016)			
Master	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Supple	ementai	y course MINT Teache	Education PLUS, Elite	Network Bavaria (EN	B) (2016)	
Modul	Module studies (Master) Physics (2019)					
Master	's degr	ee (1 major) Nanostruc	iure rechnology (2020) 020))		
Master	's teacl	ning degree Gymnasiu	m MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	020)
						· · · ·
Master's w	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	e generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- logie - 2021	page 50 / 106



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)

Module title Abbreviation						
Curren	t Topics	s in Physik			11-EXP6A-161-m01	
Modul	e coord	inator		Module offered by		
chairp	erson o	f examination committe	e	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. cor	n pl. 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					
Curren univer:	t topics sity or s	in Experimental or The tudy abroad.	oretical Physics. Credi	ted academic achiev	ements, e.g. in case	of change of
Intend	ed learı	ning outcomes				
The stu Theore subdis knowle	udents I etical Ph cipline edge. Th	nave advanced compete ysics of the Master's pr of Physics and understa ney are able to classify t	encies corresponding ogramme of Nanostru and the measuring and he subject-specific co	to the requirements of cture Technology. Th d/or calculation meth ntexts and know the	of a module of Exper ey have knowledge nods necessary to ac application areas.	imental or of a current cquire this
Course	es (type	, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (3) +	R (1)					
Metho ster, ir	d of ass Iformati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
If a wri stead of asse nation Langua	tten exa take the essmen date at age of a	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 candidate er must inform studen d/or English	ent, this may be chan e each or an oral exa ts about this by four	nged and assessmen mination in groups. weeks prior to the or	nt may in- If the method riginal exami-
Alloca	tion of p	olaces				
Additi	onal inf	ormation				
Worklo	bad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Modul	e appea	urs in				
Maste	Master's degree (1 major) Physics (2016)					
Master's degree (1 major) Nanostructure Technology (2016)						
Maste	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Supple	ementar	y course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2016)	
Modul		es (Bachelor) Physics (2 (Master) Physics (200	01 <i>9)</i>			
Master	's degr	ee (1 major) Nanostruct	.97 ure Technology (2020)			
Maste	r's degr	ee (1 major) Physics (20	20)			
	-					
Master's w	ith 1 majoi	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 52 / 106

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 title Ab					Abbreviation
Curren	t Topic	s in Physik			11-EXP7-161-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. com	pl. of module(s)	
7	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Approval from exam	ination committee re	equired.
Conten	lts				
Current change	t topics e of univ	of Experimental and The versity or study abroad.	oretical Physics. Acci	redited academic ac	hievements, e.g. in case of
Intend	ed lear	ning outcomes			
The stu Theore subdis knowle	idents l tical Ph cipline edge. Th	have advanced competer lysics of the Master's pro of Physics and understar ney are able to classify th	ncies corresponding t gramme of Nanostruc nd the measuring and e subject-specific col	o the requirements o cture Technology. Th I/or calculation meth ntexts and know the	of a module of Experimental or ey have knowledge of a current nods necessary to acquire this application areas.
Course	s (type	, number of weekly conta	ct hours, language –	· if other than Germa	n)
V (3) +	R (1)				· ·
Method ster, in written or oral pages) If a writ stead t of asse nation Langua Allocat Additio	Wethod 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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places Additional information				
210 h	au				
Teachi	ng cycl	a			
Teacini	leaching cycle				
 Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module	e appea	urs in			
Master Module Master Master	's degr e studie 's degr 's degr	ee (1 major) Nanostructur es (Bachelor) Physics (20 ee (1 major) Nanostructur ee (1 major) Quantum Tec	re Technology (2016) 19) re Technology (2020) chnology (2021)		

Module	Module title Abbreviation					
Current	t Topic	s in Physik			11-EXP8-161-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. com	pl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate	Approval from exam	ination committee re	equired.	
Conten	ts					
Current change	topics of univ	of Experimental and The versity or study abroad.	oretical Physics. Acc	redited academic acl	hievements, e.g. in case of	
Intende	ed lear	ning outcomes				
The stu Theoret subdise knowle	dents tical Ph cipline dge. Th	have advanced competer hysics of the Master's pro- of Physics and understar hey are able to classify th	ncies corresponding t gramme of Nanostruc nd the measuring and e subject-specific con	o the requirements of cture Technology. The I/or calculation methe ntexts and know the	of a module of Experimental or ey have knowledge of a current nods necessary to acquire this application areas.	
Course	s (type	, number of weekly conta	ct hours, language –	· if other than Germa	n)	
V (4) +	R (2)	,	, , , , , , , , , , , , , , , , , , , ,		,	
Method ster, inf written or oral pages) If a writ stead ta of asse nation Langua Allocat Morklo	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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places 					
240 h						
Teachi	ng cycl	e				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	appea	ars in				
Master Master Master Module	's degr 's degr 's degr e studie	ee (1 major) Nanostructur ee (1 major) Nanostructur ee (1 major) Quantum Tec es (Master) Quantum Tecl	re Technology (2016) re Technology (2020) chnology (2021) hnology (2021)			

Module	title				Abbreviation
Additio	nal Qu	alifications			11-EXZ5-161-m01
Module	coord	inator		Module offered by	
chairpe	rson of	examination committee		Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate	Approval from exam	ination committee re	equired.
Conten	ts				
Additio abroad.	nal skil	lls for engineers. Accredi	ted academic achieve	ements, e.g. in case	of change of university or study
Intende	ed learr	ning outcomes			
The stur gree pro or indus	dents ł ogramn strial re	nave advanced competer ne of Nanostructure Tech esearch.	ncies corresponding t nology. They have qu	o the requirements o alifying knowledge f	of a module of the Master's de- for an occupation in the industry
Courses	s (type,	number of weekly conta	ct hours, language —	if other than Germa	n)
V (2) + F	R (2)				
ster, inf written or oral e pages) If a writ stead ta of asses nation o Langua Allocati Additio	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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places Additional information				
Worklo	ad				
150 h					
Teachin	ng cycle	9			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
 Module	appea	rs in			
Master' Master' Master'	Module appears in Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Quantum Technology (2021)				

Module	title				Abbreviation	
Additio	nal Qu	alifications			11-EXZ6-161-m01	
Module	e coord	inator		Module offered by		
chairpe	erson of	f examination committee		Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate	Approval from exam	ination committee re	equired.	
Conten	ts					
Additio abroad	nal ski	lls for engineers. Accredit	ted academic achieve	ements, e.g. in case	of change of university or study	
Intende	ed learr	ning outcomes				
The stu gree pro or indu	dents l ogramr strial re	nave advanced competer ne of Nanostructure Tech esearch.	ncies corresponding t nology. They have qu	o the requirements o alifying knowledge f	of a module of the Master's de- for an occupation in the industry	
Course	s (type,	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (3) +	R (1)					
ster, inf written or oral of pages) If a writ stead ta of asse nation of Langua Allocat Additio	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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 Allocation of places Additional information					
Worklo	ad					
180 h						
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)		
 Module	annea	in in				
Master	's degr	e (1 major) Nanostructur	re Technology (2016)			
Master'	's degre	ee (1 major) Nanostructur	re Technology (2020)			
Master	's degre	ee (1 major) Quantum Teo	chnology (2021)			

Module	title				Abbreviation
Field Theory in Solid State Physics					11-FFK-201-m01
Module coordinator Module offer				Module offered by	
Managi and Ast	ng Dire rophys	ctor of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	d of grading	Only after succ. com	ıpl. of module(s)	
8	numer	ical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions An outline could be: 1. Single-particle Green's function 2. Review of second quantization 3. Diagrammatic method using many particle Green's functions at temperature T=0 4. Diagrammatic method for finite T 5. Landau theory of Fermi liquids 6. Superconductivity 7. One-dimensional systems and bosonization Intended learning outcomes Working knowledge of the methods of quantum field theory in a non-relativistic context. Ability to study proper- ties of Fermi liquids (and bosonic systems) beyond the one-particle picture. Acquisition of methods which are es- sential for the understanding the effects of interactions, including superconductivity and the Kondo effect.					
	\mathbf{s} (type,	number of weekly conta			
Module	taught	in: German or English			
Method ster, inf	l of ass ormati	essment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
written oral exa ges) or If a writ stead ta of asses nation o Langua Assessi	written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pa- ges) or 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				
Allocati	ion of p	laces			
Additional information					
Worklo	ad				
240 h					
Teachin	ig cycle	9			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	

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Module appears in

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)

Module	Module title Abbreviation					
Solid S	Solid State Physics 2 11-FK2-201-m01					
Module	e coordinator		Module offered by			
Manag	ing Director of the Institute of Ar	plied Physics	Faculty of Physics a	nd Astronomy		
ECTS	Method of grading	Only after succ. com	pl. of module(s)	,		
8	numerical grade					
Duratio		Other prerequisites				
	1 competer graduate Approval from examination committee required					
Conten	its					
 Elect a. Elect b. Bloc c. Elect 2. Sem a. Elect b. Ferm c. Elect d. Bolt: 3. The a. Macc b. Pola plasmod c. Ferrod 4. Sem a. Char b. Intrific. Doped d. Physic e. Hete 5. Mag a. Atom b. Dia- c. Ferrod 6. Suppo a. Phere b. Mod c. Tunr 	trons in a periodic potential - the trical and thermal transport theorem trons i-classical models of dynamic p trical transport in partially and c ni surfaces; measurement techni trical transport in external magn zmann-equations of transport dielectric function and ferroelect roscopic electrodynamics and m trizability of solids, of lattices, of ons, inter-band transitions, Wan omagnetism iconductors racteristics nsic semiconductors ed semiconductors ed semiconductors sics and applications of p-n junc erostructures netism nic dia- and paramagnetism and paramagnetism in metals omagnetism erconductivity nomena lels of superconductivity nel experiments und application	e band structure rocesses ompletely filled band iques etic fields trics icroscopic theory valence electrons an nier-Mott excitons	s 1d quasi-free electro	ns; optical phonons, polaritons,		
Intend	ed learning outcomes					
Knowle ciples	edge of effects, concepts and mo and with applications of experin	odels in advanced sol nental methods.	lid state physics. Far	niliarity with the theoretical prin-		
Course	es (type, number of weekly conta	ct hours, language —	if other than Germa	n)		
V (4) + Module	V (4) + R (2) Module taught in: German or English					
Metho ster, in	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)					
written oral ex ges) or	written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pa- ges) or presentation/talk (approx. 30 minutes).					
It a wri stead t of asse nation	tten examination was chosen as take the form of an oral examina essment is changed, the lecturer date at the latest.	method of assessme tion of one candidate must inform student	ent, this may be char e each or an oral exal s about this by four v	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-		

Master's with 1 major Quantum Technology (2021)

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) 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)

Modul	Module title Abbreviation					
Solid S	State Sp	ectrocopy			11-FKS-161-m01	
Modul	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of A	Applied Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	, , , , , , , , , , , , , , , , , , ,	
6	nume	rical grade				
Durati	on		Other prerequisites			
1 seme	ester	graduate				
Conter	Contents					
Single- micros	and ma	any-particle pictures of -ray spectroscopy.	electrons in solids, lig	ht-matter interaction	, optical spectrosco	py, electron
Intend	ed learı	ning outcomes				
The stu types o develo	udents l of spect pments	nave specific and advan roscopy and their fields in research.	iced knowledge in the of application. They u	field of solid-state s inderstand the theor	pectroscopy. They k etical principles and	now different I the current
Course	es (type	, number of weekly cont	act hours, language –	- if other than Germa	n)	
V (3) + Modul	R (1) e taugh	t in: German or English				
Metho ster, in	d of ass Iformati	essment (type, scope, l on on whether module	anguage — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
If a wri stead t of asse nation Assess	tten exa take the essmen date at sment o	amination was chosen a form of an oral examin t is changed, the lecture the latest. ffered: In the semester i ssessment: German and	is method of assessme ation of one candidate or must inform student in which the course is d/or English	ent, this may be char e each or an oral exa s about this by four offered and in the su	nged and assessmen mination in groups. weeks prior to the or ubsequent semester	nt may in- If the method riginal exami-
	tion of r		0.1			
Alloca		haces				
Additio	onal info	ormation				
	-		_			
Worklo	bad					
180 h						
Teachi	ng cycl	9				
Poforre		IPOI (examination reg		degree programmes)		
Modul	e appea	irs in				
Master	r's degr	ee (1 maior) Mathematic	cs (2016)			
Master	's degr	ee (1 major) Physics (20	16)			
Master	Master's degree (1 major) Nanostructure Technology (2016)					
Master	's degr	ee (1 major) Computatio	nal Mathematics (201	6)		
Master	's teacl	ning degree Gymnasium	MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (2	016)
Supple	ementar	y course MINT Teacher I	Education PLUS, Elite	Network Bavaria (EN	B) (2016)	
Master	r's degre	ee (1 major) Computatio	nal Mathematics (201	9)		
Master	's degr	ee (1 major) Mathematic	cs (2019)			
Master's w	vith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 62 / 106

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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 with 1 major Quantum Technology (2021)

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Module	Module title Abbreviation					
Visiting	Resea	irch			11-FPA-161-m01	
Module	coord	inator		Module offered by		
chairpe	rson of	examination committee		Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	,	
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
		graduate	Approval from exam	ination committee re	equired.	
Content	ts					
Indeper tific exp to other	ndent v perimer r unive	vork on a current researc nts including analysis and rsities or research institu	h topic of Experiment d documentation of tl tes.	al and Theoretical P he results, especially	hysics. Implementation of scien- y in the context of research visits	
Intende	d learr	ning outcomes				
The stu conduc	dents a t and a	are able to independently nalyse scientific experim	work on a current re ents and to documer	search area of Exper It the results.	imental or Theoretical Physics, to	
Courses	s (type	number of weekly conta	ct hours, language —	if other than Germa	n)	
R (o)						
Method ster, inf	l of ass ormati	essment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
project Langua	report ge of a	(10 to 20 pages) ssessment: German and/	or English			
Allocati	on of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachin	ig cycl	9				
Referre	d to in	LPOI (examination regu	lations for teaching-d	legree programmes)		
Module	appea	rs 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)						
Master' Master'	Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020)					
Master' Supplei Master'	s teach mentar s deor	ning degree Gymnasium N y course MINT Teacher Ec ee (1 major) Quantum Tec	MINT Teacher Educati ducation PLUS, Elite N hnology (2021)	on PLUS, Elite Netwo Network Bavaria (ENI	ork Bavaria (ENB) (2020) B) (2020)	

Module	Module title Abbreviation				
Profess	sional S	Specialization Quantum	Technology		11-FS-N-212-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. com	pl. of module(s)	
15	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Introdu arch tha require	ction to at are o d unde	o current experimental, th of particular relevance for rrlying fundamental topic	neoretical or enginee the envisaged topic s.	ring research topics of the master thesis	within quantum technology rese- . A seminar talk summarizing the
Intende	ed lear	ning outcomes			
Thorous tum tec ability t	gh und :hnoloរ្ to pres	erstanding of a current ex gy research chosen for the ent and convey this know	xperimental, theoreti e master thesis. In-de /ledge in a seminar ta	cal or engineering re epth knowledge of th alk.	search topic in the field of quan- ne current state of research and
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			
Methoo ster, inf	d of ass formati	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
talk wit Langua	h discu ge of a	ussion (30 to 45 minutes) ssessment: German and,	/or English		
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
450 h					
Teachir	Teaching cycle				
	<u> </u>				
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Module		ars in			
Master	's degr	ee (1 major) Ouantum Teo	chnology (2021)		

Modul	Module title Abbreviation					
Optica	Optical Properties of Semiconductor Nanostructures 11-HNS-161-m01					
Modul	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duration Module level Other prerequisites						
Conter	Contents					
Semico or mac ging th tures o with a of nove for qua	onducto roscopi eir size f varyin focus o el optoe intum c	or nanostructures are fre c crystals, their electron . The lecture addresses g dimensions (2D, 1D, o n optical properties and electronic and quantum ommunication and qua	quently referred to as nic, optical and magne technological challen D). It provides the bas light-matter coupling photonic devices base ntum computing archi	"artificial materials" etic properties can be ges in the preparatic sic theoretical conce . Moreover, it discus ed on such nanostru tectures.	In contrast to atom e systematically tailo on of semiconductor pts to describe their ses the challenges a ctures, including bui	s, molecules ored by chan- nanostruc- properties, and concepts ilding blocks
Intend	ed lear	ning outcomes				
The stu knowle device	dents l dge of s. They	know the theoretical prin the technological metho are able to apply their k	nciples and characteri ods to fabricate such s nowledge to problems	stics of semiconduc structures, and of the s in this field of resea	tor nanostructures. T eir applications to no arch.	They have ovel photonic
Course	s (type	, number of weekly cont	act hours, language –	- if other than Germa	ın)	
V (3) + Module	R (1) e taugh	t in: German or English	_			
Metho ster, in	d of ass formati	s essment (type, scope, l on on whether module o	anguage — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written or oral pages) If a wri stead t of asse nation Assess Langua	examin examin or pres tten exa ake the essmen date at ment o age of a	nation (approx. 90 to 12 ation in groups (groups centation/talk (approx. 3 amination was chosen a form of an oral examina t is changed, the lecture the latest. ffered: In the semester i ssessment: German and	o minutes) or oral exa of 2, approx. 30 minu 30 minutes). s method of assessme ation of one candidate r must inform student n which the course is d/or English	mination of one can ites per candidate) o ent, this may be cha e each or an oral exa is about this by four offered and in the su	didate each (approx r project report (app nged and assessmen mination in groups. weeks prior to the on ubsequent semester	. 30 minutes) rox. 8 to 10 nt may in- If the method riginal exami-
Allocat	ion of r	olaces				
Additio	onal inf	ormation				
Worklo	ad					
180 h	180 h					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master	Master's degree (1 major) Mathematics (2016)					
Master	's degr	ee (1 major) Physics (20	16)			
Master	's degr	ee (1 major) Nanostructu	re Technology (2016)			
Master's w	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 66 / 106

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)

UNIVERSITÄT

WÜRZBURG

Semiconductor Physics 11-HPH-zon-mo1 Module coordinator Module offered by Anaging Director of the institute of Applied Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compL of module(s) 6 numerical grade Duration Module tevel Other prerequisites 1 semester graduate Contents	Module title					Abbreviation	
Module coordinator Module offered by Nanaging Director of the Institute of Applied Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. cont. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Contents Contents The lecture deals with the fundamental properties of semiconductors. It begins with an analysis of the crystal structure, and structure, and structures of monolithic semiconductors. It then turns to examining semiconductor heterostructures, and structures, and model specially lectures in the program. Courses (type, number of weekly contact hours, language — if other than German) V (9) + R () 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 abouts) written examination in groups (groups of 2, approx, 30 minutes) or	Semico	nducto	r Physics			11-HPH-201-m01	
Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy ECTS Mett→of grading Only after succ. compl. of module(s) Duration Module level Other prerequisites 1 semester gradue Contents The lecture deals with the fundamental properties of semiconductors. It begins with an analysis of the crystal structure, leading to methods for describing band structures. These form a basis for discussing optical and electrical properties, especially in the case of lowered dimensionality systems. Examples are selected from current research activities. Intended learning outcomes To provide the student with a working knowledge semiconductors pertaining to crystal structure, symmetries, and band structures, and selectrical and optical properties. This establishes a solid basis preparing him for the more largeted specially lectures in the program. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taugith in: German or English	Module	e coordi	inator		Module offered by		
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6 mumerical grade	ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
Duration Module level Other prerequisites 1 semester gradual Contents Enderuter deals with the fundamental properties of semiconductors. It begins with an analysis of the crystal structure, leading to methods for describing band structures. These form a basis for discussing optical and electrical properties, especially in the case of lowered dimensionality systems. Examples are selected from current research activities. Intended learning outcomes To provide the student with a working knowledge semiconductors pertaining to crystal structure, symmetries, and band structures, as well as electrical and optical properties. This establishes a solid basis preparing him for the more targeted specially lectures in the program. 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 earn a bonus) written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of z, 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 or fore dod assessment, this may be changed and assessment may instead take the form of an oral examination or fore dod assessment is offered and in the subsequent semester Addicator b Learning cycle Grade appears in whin	6	numei	rical grade				
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ges) or 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 Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Quantum Technology (2021) IMU Würzburg • generated 30-Mär:2024 • exam. reg. da- tar cord Master (120 CCTS) Quantentechnologie - 2021	oral exa	aminati	on in groups (groups o	f 2, approx. 30 minutes	s per candidate) or pi	roject report (approx	. 8 to 10 pa-
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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 	stead ta	ake the	form of an oral examin	as method of assessing	e each or an oral exar	nination in groups.	If the method
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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 Referred to in LPO I (examination regulations for teaching-degree programmes) Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (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	nation	date at	the latest.				-
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Additional information	Allocat	ion of p	olaces				
Additional information page 68 / 106 Morkload Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in 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) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021 page 68 / 106							
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Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in 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 with 1 major Quantum Technology (2021)	180 h						
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Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in 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 with 1 major Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021							
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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 with 1 major Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021 Page 68 / 106	Module	e appea	rs in				
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 with 1 major Quantum Technology (2021)	Master'	's degre	ee (1 major) Nanostruct	ure Technology (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 with 1 major Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021	Master'	's degre	ee (1 major) Physics (20	020)			
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's with 1 major Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021	Master'	's teach	ning degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)
Master's degree (1 major) Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021 page 68 / 106	Supple	mentar	y course MINT Teacher	Education PLUS, Elite I	Network Bavaria (ENE	3) (2020)	
Master's with 1 major Quantum Technology (2021) JMU Würzburg • generated 30-Mär-2024 • exam. reg. da- ta record Master (120 ECTS) Quantentechnologie - 2021 page 68 / 106	Master	's degre	ee (1 major) Quantum T	echnology (2021)			
	Master's wi	th 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa r (120 ECTS) Quantentechnolo	im. reg. da- ogie - 2021	page 68 / 106

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

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)

Module	e title		Abbreviation					
Magnetism 11-MAG-161-m01								
Module coordinator				Module offered by	<u>.</u>			
Managing Director of the Institute of Ar		pplied Physics	Faculty of Physics and Astronomy					
ECTS	Metho	od of grading	Only after succ. con	succ compl of module(s)				
6	nume	rical grade						
Duratio	n l	Module level	Other prerequisites					
1 semester graduate			-					
Contents								
Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain struc- ture, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo ef- fect.								
Intende	ed learr	ning outcomes						
The students know basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas; they have competencies in independently working on problems of these areas; they are able to evaluate the accuracy of observations and analyses.								
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) written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10								
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. Assessment offered: In the semester in which the course is offered and in the subsequent semester Language of assessment: German and/or English								
Allocation of places								
Additional information								
Workload								
180 h								
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 degre	ee (1 major) Nanostructu	re Technology (2016)					
Master	's degre	ee (1 major) Computation	nal Mathematics (201	6)		0		
Master	's teacł	ning degree Gymnasium	MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)		
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)								
Master's wi	ith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex r (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 70 / 106		

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)

Module title	Abbreviation							
Master Thesis Quantum Technology	11-MA-N-212-m01							
Module coordinator		Module offered by						
chairperson of examination committe	e	Faculty of Physics and Astronomy						
ECTS Method of grading	Only after succ. con	npl. of module(s)						
30 numerical grade								
Duration Module level	Other prerequisites	i						
1 semester graduate								
Contents								
Independent work on an experimental, theoretical or ingeneering research task within nanotechnology research, in particular using state-of-the-art methods and according to scientific aspects. Writing of the master thesis.								
Intended learning outcomes								
Ability to independently work on an experimental, theoretical or engineering task in quantum technology rese- arch, in particular according to state-of-the-art methods and scientific aspects, and to discuss and present it in a written final thesis.								
Courses (type, number of weekly contact hours, language — if other than German)								
No courses assigned to module								
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)								
Master's thesis (750 to 900 hours total) Language of assessment: German and/or English								
Allocation of places								
Additional information								
Time to complete: 6 months.								
Workload								
900 h								
Teaching cycle								
Referred to in LPO I (examination regulations for teaching-degree programmes)								
Module appears in								
Master's degree (1 major) Quantum Technology (2021)								
Module lille	Abbreviation							
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Scientific Methods and Project Manag	nology	11-MP-N-212-m01						
Module coordinator		Module offered by						
chairperson of examination committee		Faculty of Physics a	and Astronomy					
ECTS Method of grading	Only after succ. com	pl. of module(s)						
15 (not) successfully completed								
Duration Module level	Other prerequisites							
1 semester graduate								
Contents								
Introduction to the scientific approach gineering or theoretical research topic Establishment of a scientific project pl	and practice, includi in the field of quantu an for the planned ma	ng project planning v m technology resear aster thesis.	within a current experimental, en- rch chosen for the master thesis.					
Intended learning outcomes								
Knowledge of the scientific approach a ring or theoretical research topic in the ty to establish a research plan for the r Ability to present the project in a semin	nd practice, including field of quantum tec naster thesis, and to nar talk.	g project planning in hnology research ch plan the required ex	a current experimental, enginee- osen for the master thesis. Abili- perimental or theoretical work.					
Courses (type, number of weekly conta	act hours, language —	if other than Germa	n)					
R (4) Module taught in: German or English								
Method of assessment (type, scope, la ster, information on whether module c	anguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-					
talk with discussion (30 to 45 minutes) Language of assessment: German and) /or English							
Allocation of places								
	-							
Additional information	-							
Workload	-							
450 h								
Teaching cycle								
Referred to in LPO I (examination regu	llations for teaching-c	legree programmes)						
Module appears in								
Master's degree (1 major) Quantum Teo	chnology (2021)							

Module title			Abbreviation		
Advanced Magnetic Resonance Imaging			11-MRI-171-m01		
Modul	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	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			
Conter	nts				
Nuclea imagin fundar this co 1) the 2) the and m 3) the 4) the	rr magne ng (MRI) nental p urse co VMR sig principl easuren concept physica	etic resonance (NMR) is a , has played a major role principles of nuclear mag vers: anal theory and signal evo es of spatial encoding, m nent parameters, of k-space and Fourier in l. methodological and teo	a quantum mechanic in the revolution of r netic resonance (reso plution (Bloch equati- agnetic resonance ir maging, and chnical possibilities	al phenomenon that nedical imaging over onance principle, rel ons), naging (MRI) and cor and limits of MRI. As	, through magnetic resonance the last 30 years. Based on the axation times, chemical shift) rresponding imaging sequences a last point, exemplary applicati-
on fiel	ds of MI	RI of biomedical research	, clinical imaging an	d non-destructive tes	sting are introduced.
Intend	ed learr	ning outcomes			
The stu ging m MRI ar	udents H agnetic Id its int	nave advanced knowledg resonance, image gener erdisciplinary contexts a	e of the mathematica ation and processing nd applications.	al-theoretical and ph g. They gain a broad (ysical principles of modern ima- overview of the field of modern
Course	es (type,	, number of weekly conta	ct hours, language –	- if other than Germa	n)
V (3) + Modul	R (1) e taugh	t in: English			
Metho ster, ir	d of ass Iformati	e ssment (type, scope, la on on whether module ca	nguage — if other than be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
a) writh nutes) prox. & If a wri stead t of asse nation Assess Langua	ten exar or c) or to 10 p tten exa take the essment date at sment o age of a	nination (approx. 90 to 1 al examination in groups ages) or e) presentation/ amination was chosen as form of an oral examina t is changed, the lecturer the latest. ffered: In the semester in ssessment: German and,	20 minutes) or b) ora (groups of 2, approx (talk (approx. 30 min method of assessme tion of one candidate must inform student which the course is (or English	al examination of one 30 minutes per can utes). ent, this may be chan e each or an oral exa is about this by four offered and in the su	e candidate each (approx. 30 mi- didate) or d) project report (ap- nged and assessment may in- mination in groups. If the method weeks prior to the original exami- ubsequent semester
Alloca	tion of p	olaces			
Additi	onal info	ormation			
Worklo	ad				
180 h					
Teachi	ng cycl	a			
		-			
Roform	ad to in	IPOL (examination rogu	lations for teaching	degree programmoc)	
Madul		rc in			
moaul	e appea	IS IN			

Master's with 1 major Quantum Technology (2021)

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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)

Module title					Abbreviation	
Nano-Optics					11-NOP-161-m01	
Module	coordi	nator		Module offered by		
Managi	ng Dire	ctor of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numer	ical grade				
1 seme	n ster	graduate	Other prerequisites			
Conten	ts					
The lect from th copy ar basis, c 2D, 1D tennas.	ture con e discu e discu quantur and o d	nveys theoretical funda ssion of the focusing o ssed. In the following, n emitters are introduc limensions are introdu	amentals, experimenta of light. Based on this, t the near-field optical n ced and their light emis ced and discussed in d	l techniques, and ap the fundamentals of nicroscopy is introdu sion in nano-enviror letail. This finally lea	plications of nano-o modern far-field opt iced and discussed. iments is derived. Pl ds to the concept of	ptics starting ical micros- As a further asmons in optical an-
Intende	ed learr	ing outcomes				
The stu retical p	dents ł orincipl	nave specific and adva es and application are	nced knowledge in the as of nano-optics and v	field of nano-optics. with current develop	They are familiar wi ments in this field.	th the theo-
Course	s (type,	number of weekly con	tact hours, language –	- if other than Germa	n)	
V (3) + I Module	R (1) taught	t in: German or English				
Methoo ster, inf	l of ass formati	essment (type, scope, on on whether module	language — if other the can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
nutes) of prox. 8 If a writ stead ta of asse nation Assess Langua	ten exa to 10 p ten exa ake the ssment date at ment of ge of as	al examination (approx. 90 (c al examination in group ages) or e) presentation mination was chosen form of an oral examin is changed, the lectur the latest. ffered: In the semester ssessment: German an	of 20 minutes) of b) of a os (groups of 2, approx n/talk (approx. 30 min as method of assessme nation of one candidate er must inform student in which the course is d/or English	. 30 minutes per can utes). ent, this may be char e each or an oral exa s about this by four offered and in the su	didate) or d) project nged and assessmer mination in groups. I weeks prior to the or	report (ap- nt may in- If the method riginal exami-
Allocal		naces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachir	ng cycle	9				
Referre	d to in	LPOI (examination reg	gulations for teaching-o	degree programmes)		
Module	appea	rs in				
Master Master Master Supple 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) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Nanostructure Technology (2020)					
Master's wi	th 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa r (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 76 / 106

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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)

Module title				Abbreviation		
Organic Semiconductors					11-OHL-161-m01	
Module	e coord	inator		Module offered by	<u> </u>	
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	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	;		
1 seme	ster	graduate				
Conten	ts					
Fundar ons.	nentals	of organic semicondu	ctors, molecular and p	olymer electronics a	nd sensor technolog	y, applicati-
Intende	ed learı	ning outcomes				
The stu	idents l	nave advanced knowle	dge of organic semicor	nductors.		
Course	s (type	, number of weekly cor	ntact hours, language –	– if other than Germa	an)	
V (3) +	R (1)					
Module	e taugh	t in: German or English	<u> </u>			
ster, in	d of ass formati	on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	ation offered — if not	every seme-
a) writt nutes) prox. 8 If a writ stead t of asse nation Assess Langua Allocat Additio	en exar or c) or to 10 p tten exa ake the essmen date at ment o age of a ion of p	nination (approx. 90 to al examination in grou ages) or e) presentatio amination was chosen form of an oral exami t is changed, the lectur the latest. ffered: In the semester ssessment: German ar places	o 120 minutes) or b) ora ps (groups of 2, approx on/talk (approx. 30 min as method of assessm nation of one candidate rer must inform studen r in which the course is nd/or English	al examination of on x. 30 minutes per car outes). ent, this may be cha e each or an oral exa ts about this by four offered and in the su	e candidate each (ap ndidate) or d) project nged and assessme mination in groups. weeks prior to the o ubsequent semester	prox. 30 mi- t report (ap- nt may in- If the method riginal exami-
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination re	gulations for teaching-	degree programmes)		
Module	e appea	irs in				
Master	's degr	ee (1 major) Physics (2	016)			
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	Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020)					
Master	's teach	ning degree Gymnasiu	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	020)
Supple	mentar	y course MINT Teachei	Education PLUS, Elite	Network Bavaria (EN	B) (2020)	
Master's w	ith 1 majoı	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 ● ex er (120 ECTS) Quantentechno	am. reg. da- logie - 2021	page 78 / 106



Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Functional Materials (2022) exchange program Physics (2023)

Module title					Abbreviation
Advanced Seminar Quantum Technology A			gy A		11-OSN-A-212-m01
Module	e coord	inator		Module offered by	
Managi	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Semina	ar on cu	rrent issues in theoretica	al or experimental ph	ysics.	
Intende	ed leari	ning outcomes			
In-dept tions, s	h know umma	ledge about a current to rizing them and presentir	pic in experimental o ng them to a peer auc	r theoretical physics lience.	. Ability to read scientific publica-
Course	s (type	, number of weekly conta	ct hours, language –	· if other than Germa	n)
S (2)					
Module	e taugh	t in: German or English			
Methoo ster, in	l of ass formati	e ssment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
talk wit Langua	h discu ge of a	ıssion (30 to 45 minutes) ssessment: German and,	/or English		
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
150 h					
Teachi	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
		· · · · · · · · · · · · · · · · · · ·			
Module	e appea	rs in			
Master	's degr	ee (1 major) Quantum Teo	chnology (2021)		
exchan	ge prog	gram Physics (2023)	C , C , C ,		

Module title					Abbreviation
Advanced Seminar Quantum Technology B			gy B		11-OSN-B-212-m01
Module	e coordi	inator		Module offered by	
Managi	ng Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	numei	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Semina	ir on cu	rrent issues in theoretica	al or experimental ph	ysics.	
Intende	ed learr	ning outcomes			
In-dept tions, s	h know ummai	ledge about a current to	pic in experimental o ng them to a peer auc	r theoretical physics lience.	. Ability to read scientific publica-
Course	s (type,	, number of weekly conta	ct hours, language –	· if other than Germa	n)
S (2)	taugh	tin, Cormon or English			
Module					tion offered if not even come
ster, in	formati	on on whether module ca	an be chosen to earn	a bonus)	tion offered — If not every serile-
talk wit Langua	h discu ge of a	ission (30 to 45 minutes) ssessment: German and,	/or English		
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
150 h					
Teachir	ng cycl	e			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	rs in			
Master	's degre	ee (1 major) Quantum Teo	chnology (2021)		
exchan	exchange program Physics (2023)				

Module title				Abbreviation		
Advanced Laboratory Course Master Part 1					11-P-FM1-161-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Methe	od of grading	Only after succ. con	npl. of module(s)		
3	(not)	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate	Preparation and saf	ety briefing.		
Conten	lts					
Princip stems, tic resc superc	les of N proper onance onduct	Nuclear, Atomic and Mole ties of solids, surfaces ar (NMR) - quantum Hall eff ivity - laser - solid-state o	cular Physics, experi nd interfaces. Experir ect - optical pumping ptics	ments on cryogenic t nents on the followir g and spectroscopy in	temperatures and correlated sy- ng topics: X-rays - nuclear magne- n the field of optics - Hall effect -	
Intend	ed lear	ning outcomes				
Knowle suing s experir experir	edge of scientifi nental nent ar	conducting experiments, ic publications, application methods. They are able to nd to present and discuss	analysing and docu on of modern evaluat o work on a task on t their results in a sci	menting experimenta ion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- idents are familiar with modern ons, to conduct and evaluate an	
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)	
P (3)						
Metho ster, in	d of ass formati	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
practic Studer fic pub succes regulat Langua	al exan Its mus licatior sfully c ions ar age of a	nination t successfully prepare, pe n) an experiment to be co omplete two experiments re laid down in the respec ssessment: German and,	erform, document (la nsidered to have suc s to be considered to tive module descript /or English	b notebook) and eva cessfully completed have successfully co ion.	aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed	
Allocat	ion of _l	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 appea	ars in				
Master Master Master Master Master exchar	Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021) exchange program Physics (2023)					

Module title			Abbreviation		
Advanced Laboratory Course Master Part 2					11-P-FM2-161-m01
Module	e coord	inator		Module offered by	
Manag	ing Dir	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
3	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Preparation and saf	ety briefing.	
Conten	ts				
Princip stems, tic resc superc	les of N proper onance onduct	Nuclear, Atomic and Mole ties of solids, surfaces ar (NMR) - quantum Hall eff ivity - laser - solid-state o	cular Physics, experi nd interfaces. Experir ect - optical pumping ptics	ments on cryogenic t nents on the followir g and spectroscopy in	temperatures and correlated sy- ng topics: X-rays - nuclear magne- n the field of optics - Hall effect -
Intend	ed lear	ning outcomes			
Knowle suing s experir experir	edge of scientif nental nent ar	conducting experiments, ic publications, applications, applications, applications, applications, applications, and to present and discuss	analysing and docur on of modern evaluat o work on a task on t their results in a sci	menting experimenta ion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- Idents are familiar with modern ons, to conduct and evaluate an
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	in)
Р (3)					
Metho ster, in	d of as format	sessment (type, scope, la ion on whether module ca	nguage — if other than an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
practic Studer fic pub succes regulat Langua	al exan its mus licatior sfully c ions ar age of a	nination t successfully prepare, po n) an experiment to be co omplete two experiments re laid down in the respec ssessment: German and,	erform, document (la nsidered to have suc s to be considered to tive module descript /or English	b notebook) and eva cessfully completed have successfully co ion.	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 appea	ars in			
Master Master Master Master Master exchar	Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021) exchange program Physics (2023)				

Module title				Abbreviation	
Advanced Laboratory Course Master Part 3					11-P-FM3-161-m01
Modul	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
3	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	Preparation and saf	ety briefing.	
Conter	Its				
Princip stems, tic reso superc	les of N proper onance onduct	Nuclear, Atomic and Mole ties of solids, surfaces ar (NMR) - quantum Hall eff ivity - laser - solid-state o	cular Physics, experi nd interfaces. Experir ect - optical pumping ptics	ments on cryogenic t nents on the followin g and spectroscopy in	temperatures and correlated sy- ng topics: X-rays - nuclear magne- n the field of optics - Hall effect -
Intend	ed lear	ning outcomes			
Knowle suing s experir experir	edge of scientifi nental nent ar	conducting experiments, ic publications, application methods. They are able to nd to present and discuss	, analysing and docu on of modern evaluat o work on a task on t s their results in a sci	menting experimenta ion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- idents are familiar with modern ons, to conduct and evaluate an
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	ın)
P (3)					
Metho ster, in	d of ass formati	sessment (type, scope, la ion on whether module ca	nguage — if other th an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
practic Studer fic pub succes regulat Langua	al exan Its mus licatior sfully c ions ar age of a	nination It successfully prepare, pe n) an experiment to be co complete two experiments re laid down in the respec ussessment: German and,	erform, document (la nsidered to have suc s to be considered to tive module descript /or English	b notebook) and eva cessfully completed have successfully co ion.	aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Allocat	ion of _l	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)	
Modul	e appea	ars in			
Master Master Master Master Master exchar	Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021) exchange program Physics (2023)				

Module title			Abbreviation		
Advanced Laboratory Course Master Part 4					11-P-FM4-161-m01
Modul	e coord	inator		Module offered by	
Manag	ing Dir	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
3	(not)	successfully completed			
Durati	on	Module level	Other prerequisites		
1 seme	ester	graduate	Preparation and saf	ety briefing.	
Conte	nts				
Princip stems, tic reso superc	oles of N proper onance onduct	Nuclear, Atomic and Mole ties of solids, surfaces ar (NMR) - quantum Hall eff ivity - laser - solid-state o	cular Physics, experi nd interfaces. Experir ect - optical pumping ptics	ments on cryogenic t nents on the followir g and spectroscopy in	emperatures and correlated sy- ng topics: X-rays - nuclear magne- n the field of optics - Hall effect -
Intend	ed lear	ning outcomes			
Knowl suing experi experi	edge of scientif mental ment ar	conducting experiments, ic publications, application methods. They are able to nd to present and discuss	analysing and docu on of modern evaluat o work on a task on t their results in a sci	menting experimenta ion systems. The stu he basis of publicati entific publication.	al results, basic knowledge of is- idents are familiar with modern ons, to conduct and evaluate an
Course	es (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)
P (3)					
Metho ster, ir	d of as Iformat	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
practic Studer fic pub succes regula Langua	al exan nts mus olicatior sfully c tions ar age of a	nination It successfully prepare, po n) an experiment to be co complete two experiments re laid down in the respect issessment: German and,	erform, document (la nsidered to have suc s to be considered to tive module descript /or English	b notebook) and eva cessfully completed have successfully co ion.	lluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed
Alloca	tion of	places			
Additi	onal inf	ormation			
Workle	bad				
90 h					
Teachi	ng cycl	e			
Referr	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	
				<u> </u>	
Modul	e appea	ars in			
Maste	's degr	ee (1 maior) Physics (201	6)		
Maste	r's degr	ee (1 major) Nanostructui	re Technology (2016)		
Maste	r's degr	ee (1 major) Nanostructui	re Technology (2020)		
Maste	r's degr	ee (1 major) Physics (202	o)		
Maste	r's degr	ee (1 major) Quantum Teo	chnology (2021)		
exchai	nge pro	gram Physics (2023)			

Module title Abbreviation					Abbreviation		
Physics	s of Adv	vanced Materials			11-PMM-161-m01		
Module	e coord	inator		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				
1 seme	ster	graduate					
Conten	ts						
Genera and su groups	l prope percon ; two-d	rties of various materi ductors; thin films, het imensional layer mate	al groups such as liquid erostructures and supe rials.	ds, liquid crystals an erlattices. Methods o	d polymers; magneti f characterising thes	ic materials se material	
Intende	ed learı	ning outcomes					
The stu	idents l	know the properties an	d characterization met	hods of some moder	n materials.		
Course	s (type	number of weekly cor	ntact hours, language –	- if other than Germa	n)		
V (3) + Module	R (1)	t in: German or English					
Method ster, in	d of ass formati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-	
pages) If a writ stead t of asse nation Assess Langua	or pres tten exa ake the ssmen date at ment o ge of a	entation/talk (approx. amination was chosen form of an oral exami t is changed, the lectur the latest. ffered: In the semester ssessment: German ar	30 minutes). as method of assessm nation of one candidate rer must inform student r in which the course is nd/or English	ent, this may be cha e each or an oral exa s about this by four offered and in the su	nged and assessmen mination in groups. weeks prior to the or ubsequent semester	nt may in- If the method riginal exami-	
Allocat	ion of p	olaces					
Additio	onal info	ormation					
Worklo	ad						
180 h							
Teachi	ng cycl	e					
		-					
Referre	d to in	IPOI (examination re	gulations for teaching-	degree programmes)			
			<u>success for teaching</u>				
Module	annea	in in					
Master	's degr	e (1 maior) Mathemat	ics (2016)				
Master	's degr	ee (1 major) Physics (2	016)				
Master	's degr	ee (1 major) Nanostruc	ture Technology (2016)				
Master	Master's degree (1 major) Computational Mathematics (2016)						
Master	's degr	ee (1 major) Functional	Materials (2016)				
Master	's teach	ning degree Gymnasiu	n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)	
Supple	inentar 's dear	y course MINT Teacher	cuucation PLUS, Elite	o) Network Bavaria (EN	Б) (2016)		
master	5 uegn	ce (I major) computati	onat mathematics (201	7/		<u>.</u>	
Master's wi	ith 1 majoı	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 86 / 106	

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)

Module title					Abbreviation	
Phenor	nenolo	gy and Theory of Supe	rconductivity		11-PTS-201-m01	
Module	e coord	inator		Module offered by		
Managi Managi and Ast	ing Dire ing Dire trophys	ector of the Institute of ector of the Institute of sics	Applied Physics and Theoretical 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 seme	1 semester graduate					
Conten	ts					
Basic P materia vention superco grams a des, ph of the F on of cu	Basic Properties of Superconductors and their Applications, Development of technological platforms, Methods of material science for calculating temperature profiles in superconductors. Overview of the phenomenology of conventional and unconventional superconductivity. Review of BCS theory and its applicability for different types of superconductors. Extension of Ginzburg-Landau theory to a quantum field theory formalism using Feynman diagrams and functional integrals. Theoretical formalism of Ward identities and response functions. Goldstone modes, phase fluctuations, and coupling to the electromagnetic field. Interpretation of the Meissner effect in terms of the Higgs mechanism. Interplay of magnetism and conventional/unconventional superconductivity.					
Intende	ed lear	ning outcomes	<u>,</u>		- / -	
Acquisi derstar arch. Ki as well tors and	ition of nding o nowled as the d their	basic knowledge abou f unconventional super ge of BCS mean-field tl Meissner effect and th fascinating connection	t superconductivity as conductivity and its in heory, the quantum-fie e Higgs mechanism. Ba with competing magn	a macroscopic quan terplay with magnetis ld theory methods no asic understanding o etic phases.	tum phenomenon. F sm in the context of ecessary to extend E f unconventional su	Profound un- current rese- BCS theory, perconduc-
Course	s (type	, number of weekly con	tact hours, language –	- if other than Germa	n)	
V (3) + Module	R (1) e taugh	t in: German or English				
Method ster, inf	l of ass formati	essment (type, scope, on on whether module	language — if other the can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written oral exa ges) or If a writ stead ta of asse nation o Langua Assess	examin aminati presen ten exa ake the ssmen date at ge of a ment o	nation (approx. 90-120 fon in groups (groups o tation/talk (approx. 30 amination was chosen form of an oral examin t is changed, the lectur the latest. ssessment: German an ffered: In the semester	minutes) or oral exami f 2, approx. 30 minutes minutes). as method of assessme nation of one candidate er must inform student in which the course is	nation of one candid s per candidate) or p ent, this may be char e each or an oral exa ts about this by four offered and in the su	late each (approx. 3 roject report (approx nged and assessmen mination in groups. weeks prior to the on ubsequent semester	o minutes) or 4. 8 to 10 pa- nt may in- If the method riginal exami-
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h	180 h					
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination reg	gulations for teaching-	degree programmes)		
Master's wi	ith 1 majoi	Quantum Technology (2021)	JMU Würzburg ● ta record Maste	generated 30-Mär-2024 • exa er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 88 / 106

Module appears in

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)

Module title				Abbreviation	
Advanc	ed The	ory of Quantum Computi	ng and Quantum Info	ormation	11-QIC-201-m01
Module	coord	inator		Module offered by	
Managi and Ast	ng Dire rophys	ector of the Institute of Th sics	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			
Contents					
1. Brief 2. Quan 3. Comp 4. Entar 5. Quan 6. Quar	summa itum th posite s ngleme itum op itum ga	ary of classical informatic neory seen from the persp systems and the Schmidt ent measures perations, POVMs, and th ates and quantum compu	on theory pective of information decomposition te theorems of Kraus iters	n theory and Stinespring	
7. Elem	ents of	the theory of decoheren	ce		
Intende	d learı	ning outcomes			
Compre Knowle depth u cepts of herence	hensiv dge of Inderst f quant e.	ve understanding of quan handling tensor products canding of the phenomen tum information theory. A	tum states and ident and dealing with qu on of entanglement. Wility to assess the li	tity matrix beyond th antum effects in mu Knowledge of the fu imitations of quantu	e usual textbook interpretation. ltipartite quantum systems. In- ndamental mathematical con- m computing arising from deco-
Courses	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)
V (3) + F Module	R (1) taugh	t in: German or English			
Method ster, inf	l of ass ormati	sessment (type, scope, la on on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-
written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pa- ges) or 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					
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Workload					
180 h					
Teachin	g rvcl	P			
	-5 cycl				
Deferre	d to in	IDOL (ovamination race)	lations for toaching	dograa programmee)	
Referre				regree programmes)	
		····- •			
Module	appea	irs in			

Master's with 1 major Quantum Technology (2021)

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)

Module title			Abbreviation			
Quantu	m Mec	hanics II			11-QM2-161-m01	
Module	coord	nator		Module offered by		
Managi and Ast	ng Dire rophys	ctor of the Institute of ics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	d of grading	Only after succ. con	npl. of module(s)		
8	numer	ical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	undergraduate				
Content	ts					
The contents of this lecture build upon and will be chosen in accordance with the topics of the Bachelor's degree course "Quantum Mechanics I". Topics might include: for QM: 1. Historical introduction 2. Single-particle states in a central potential 3. Principles of quantum mechanics 4. Spin and angular momentum 5. Approximations of energy eigenvalues 6. Approximations for time-dependent problems 7. Second quantisation 8. Potential scattering 9. General scattering theory 10. Canonical formalism 11. Charged particles in electromagnetic fields 12. Quantum theory of radiation 13. Quantum entanglement Intended learning outcomes						
The con	npletio	n of this course is high	ly recommended.	- if other than Germa	n)	
$V(\lambda) \pm 0$	$\frac{1}{2}$	the children of the children o			,	
Module	taught	in: German or English				
Method ster, inf	l of ass formati	essment (type, scope, on on whether module	language — if other the can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester language of assessment: German and/or English						
Allocation of places						
Additio	nal info	ormation				
arch	au					
240 11						
Master's wit	th 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • exa r (120 ECTS) Quantentechnolo	am. reg. da- ogie - 2021	page 92 / 106

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)

Module title				Abbreviation			
Quantum Transport 11-QTR-201-m01							
Modul	e coord	inator		Module offered by	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. cor	npl. of module(s)			
6	nume	rical grade					
Duratio	on	Module level	Other prerequisites	i			
1 seme	ester	graduate					
Conter	nts						
The lecture addresses the fundamental transport phenomena of electrons in solids where Electron-electron inter- action and the wave nature are the determining factors. This includes the diffusive and ballistic transport regime as well as the Coulomb blockade. Observations of electron interference effects, conductance quantization and the quantum Hall effect will be discussed. Thermoelectric properties of electronic system and the phenomenon of superconductivity will be examined as well.Low dimensional electron systems and its quantum mechanical description are the basis of this lecture. Relevant material systems are semiconductor heterostructures as well as topological insulators, topological semimetals, and topological superconductors. The content will be guided							
Intend	ed learı	ning outcomes					
Workin to disc	ıg know uss res	ledge of basic transpor ults critical.	t experiments, its ana	lysis and its interpret	tation which enables	the student	
Course	es (type	, number of weekly con	tact hours, language –	- if other than Germa	ın)		
V (3) + Modul	R (1) e taugh	t in: German or English					
Metho ster. in	d of ass Iformati	essment (type, scope, on on whether module	language — if other th can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-	
written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pa- ges) or 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							
Allocat	tion of r			onered and in the st	absequent semester		
		///////////////////////////////////////					
	nal inf	ormation					
Worklo							
180 h							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Master	's degri	ee (1 major) Nanostruct ee (1 major) Physics (20	ure rechnology (2020) 320)	1			
Master	's teach	ning degree Gymnasiun	n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (20	020)	
Master's w	vith 1 major	Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 94 / 106	



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

Module title					Abbreviation	
Spintro	onics				11-SPI-161-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	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	its					
This lee magne spin dy	cture co toresist /namics	vers the basic principles ance and tunnel magnet and current-induced sp	of spin transport, wi oresistance. As a las in phenomena.	th a particular emph t point, we discuss n	asis on the phenom ew phenomena fron	ena of giant n the field of
Intend	ed learr	ning outcomes				
The stu mation nel ma	idents l techno gnetore	know the basic principles logy. They have gained a esistance).	s of spin transport mo an overview of curren	odels and the applica t findings in this field	ations of spin transp d (giant magnetoresi	ort in infor- stance, tun-
Course	s (type,	, number of weekly conta	ict hours, language –	- if other than Germa	n)	
V (3) + Module	R (1) e taugh	t in: German or English				
Metho	d of ass	essment (type, scope, la	inguage — if other th	an German, examina	tion offered — if not	every seme-
ster, in	formati	on on whether module ca	an be chosen to earn	a bonus)		
or oral pages) If a wri stead t of asse nation Assess Langua	or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester					
Allocat	ion of p	olaces				
			-			
Additic	nal inf	ormation				
Additio						
Worklo	ad					
180 h						
Teachi	ng cycl	a				
		•	<u>.</u>			
Poforra	d to in	IPOL (examination regu	lations for teaching	legree programmes)		
Referred to In LFOT (examination regulations for teaching-degree programmes)						
 Module appears in						
Master's degree (1 major) Mathematics (2016)						
Master	's degre	ee (1 major) Physics (201	6)			
Master	Master's degree (1 major) Nanostructure Technology (2016)					
Master's degree (1 major) Computational Mathematics (2016)						
Master	's teach	ning degree Gymnasium	MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)
Supple	mentar	y course MINT Teacher E	ducation PLUS, Elite	Network Bavaria (ENI	B) (2016)	-
Master	's degre	ee (1 major) Computation	al Mathematics (201	9)		
Master's w	ith 1 major	Quantum Technology (2021)	JMU Würzburg •	generated 30-Mär-2024 • exa	am. reg. da- ogie - 2021	page 96 / 106

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)

Module	e title				Abbreviation	
Scanni	ng Prol	e Technologies			11-SPT-211-m01	
Module	e coord	inator		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. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
Basic t	heoreti	cal principles of scann	ing force, tunneling, ar	nd near-field optical r	nicroscopy; basic pr	inciples of
engine	e scienc ering∙ r	e; tip-sample interacti neasurement modes e	ons; design principles	and material conside	frictions; fundament	conv etc.
basic p	principle	es of processing and p	resenting microcopy da	ata; measurement te	chniques and their a	pplication:
lock-in	, phase	-lock loop, etc.				
Intende	ed learı	ning outcomes				
Studen	ıt acqui	res specific knowledge	e in scanning probe mic	croscopy. He/she kno	ows the basic theore	tical princip-
les, is a	aware o	f basic design principl	es, knows pros and col	ns of various materia	lls, and is familiar of	measure-
Course	ioues,	number of wookly oor		if other then Corme		i the netu.
		, number of weekly cor	ildel nours, language -	- II Other than Germa	III <i>)</i>	
V (3) + Module	e taugh	t in: German or English	I			
Metho	d of ass	essment (type, scope,	language — if other th	an German, examina	tion offered — if not	every seme-
ster, in	formati	on on whether module	e can be chosen to earn	a bonus)		
a) writt	en exar	nination (approx. 90 to	o 120 minutes) or b) ora	al examination of one	e candidate each (ap	prox. 30 mi-
nuces)	to 10 n	ages) or e) presentatio	ps (groups of 2, approx	uites).	ididate) of d) project	report (ap-
If a writ	tten exa	mination was chosen	as method of assessm	ent, this may be cha	nged and assessme	nt may in-
stead t	ake the	form of an oral exami	nation of one candidate	e each or an oral exa	mination in groups.	If the method
of asse	essmen data at	t is changed, the lectur	rer must inform studen	ts about this by four	weeks prior to the o	riginal exami-
Langua	uale al	the latest. ssessment: German ar	nd/or English			
Assess	ment o	ffered: In the semester	r in which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Workload						
180 h						
Teaching cycle						
Teaching cycle: annually, after announcement						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Nanostructure Technology (2020)						
Master's degree (1 major) Physics (2020)						
Master's degree (1 major) Quantum Technology (2021)						
exchan	ige prog	gram Physics (2023)				
Mactaria	ith 4	Quantum Taskaslass (see)	INALL MARY	concreted as Maria	am rag da	page all list
waster's w	пп 1 тајо	Quantum rechnology (2021)	ta record Maste	er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 98 / 106

Module title					Abbreviation	
Surface	Scien	ce			11-SSC-172-m01	
Module	coord	inator		Module offered by		
Managi	ng Dire	ector of the Institute of A	Applied 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			
Conton		graduale				
Relevar Atomic involvir experin couplin	Relevance of surfaces and interfaces, distinction between bulk phases, classical description, continuum models. Atomic structure: Reconstructions and adsorbates, surface orientation and symmetries. Microscopic processes involving surfaces. Thermodynamics of surfaces, adsorption and desorption, equilibria, thermodynamic phases, experimental characterisation. Electronic structure of surfaces, chemical bonding, surface conditions, spin-orbit coupling: Rashba effect and topological insulators. Magnetism on surfaces.					
Intende	ed learn					.1
The stu and cor perime	dents i ntexts o ntal teo	have gained an overview of physical peculiarities hniques and their spec	v of the diverse aspect of surfaces and interfa ific application possib	is of surface physics aces. Additionally, th ilities in the context	and especially know ley know the most in of surface physics.	r the causes nportant ex-
Course	s (type	number of weekly con	act hours, language –	- if other than Germa	n)	
V (3) + Module	R (1) e taugh	t in: Englisch				
Methoo ster, inf	l of ass formati	essment (type, scope, on on whether module	language — if other tha can be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
nutes) 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester					report (ap- It may in- f the method iginal exami-	
Allocat	ion of r					
		haces	_			
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachir	ng cycl	a				
	13 09 00	•				
Referred to in LPO L (examination regulations for teaching-degree programmes)						
Module appears in						
Master' Master' Master' Supple Master' ^{Master's wi}	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 degree (1 major) Nanostructure Technology (2020)					
			ta record Maste	r (120 ECTS) Quantentechnol	ogie - 2021	

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) Quantum Technology (2021) exchange program Physics (2023)

Module title					Abbreviation
Τοροlο	Topological Effects in Solid State Physics				
Module	coord	inator		Module offered by	
Managi and Ast	ng Dire rophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Method of grading Only after succ. compl. of module(s)				
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
1. Geom 2. Math 3. Time 4. Hall o 5. Bulk- 6. Grap 7. Quan 8. Z2 in	 Geometric phase in quantum systems Mathematical basics of topology Time-reversal symmetry Hall conductance and Chern numbers Bulk-boundary correspondence Graphene (as a topological insulator) Quantum Spin Hall insulators Z2 invariants 				
9. lopo	logical	superconductors			
 9. Topological superconductors Intended learning outcomes In-depth theoretical understanding of the topological concepts in quantum physics related to solid state systems. Ability to connect their knowledge with different research activities at the Department of Physics and Astronomy at Würzburg University. Courses (type, number of weekly contact hours, language — if other than German) V (4) + R (1) 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) written examination (approx. 90-120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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 					
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Workload					
240 h					
Teachir	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
Module	appea	ars in			

Master's with 1 major Quantum Technology (2021)

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)

Module title			Abbreviation			
Theore	tical So	olid State Physics			11-TFK-161-m01	
Module	e coord	inator		Module offered by		
Manag and As	ing Dire trophy:	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTSMethod of gradingOnly after succ.				npl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	its					
The contents of this two-term course will depend on the choice of the lecturer, and may include parts of the syllabus which could alternatively be offered as "Quantum Many Body Physics" (11-QVTP). A possible syllabus may be: 1 Band structure (Sommerfeld theory of metals, Bloch theorem, k.p approach and effective Hamiltonians for to- pological insulators (TIs), bulk-surface correspondence, general properties of TIs) 2 Electron-electron interactions in solids (path integral method for weakly interacting fermions, mean field theo- ry, random phase approximation (RPA), density functional theory) 3 Application of mean field theory and the RPA to magnetism						
Intend	ed lear	ning outcomes				
During sics, w cepts a sics" a	the two hich ar and the nd "Qu	o-semester lecture, the st e addressed in classical t methods of description. antum Mechanics".	udents acquire a bas textbooks, and there The course builds up	sic understanding of by advance their kno on the courses "Exp	many topics of Solic wledge of the under erimental Condense	l-State Phy- lying con- d Matter Phy-
Course	s (type	, number of weekly conta	ict hours, language –	- if other than Germa	n)	
V (4) + Module	R (2) e taugh	t in: German or English				
Metho ster, in	d of as format	sessment (type, scope, la ion on whether module ca	inguage — if other th an be chosen to earn	an German, examina a bonus)	tion offered — if not	every seme-
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester						
Allocat	ion of	olaces				
Additio	onal inf	ormation				
Workload						
240 h						
Referre	ea to in	LPUI (examination regu	lations for teaching-	uegree programmes)		
Master's w	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg • ta record Maste	generated 30-Mär-2024 • ex er (120 ECTS) Quantentechnol	am. reg. da- ogie - 2021	page 103 / 106

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)

Module title					Abbreviation	
Theore	tical Q	uantum Optics			11-TQO-221-m01	
Module	e coord	inator		Module offered by		
Manag and As	ing Dire trophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade		• • • • •		
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Contents						
1. Sem 2. Inter 3. Mast 4. Cohe 5. Cohe 6. Phot	 Semi-classical atom-field interactions Interaction of atoms with quantized light fields and dressed-atom model Master equation and open systems Coherence and interference effects Coherent light propagation in resonant media Photon statistics and correlations 					
7. Quai	ntum o	ptics of many-body syste	ms			
Intend	ed lear	ning outcomes				
Compro cal leve ln-dept tistics a Lindbla on effe diance	Comprehensive understanding of phenomena involving light and its interaction with atoms at the microscopi- cal level. Knowledge of density matrix formalism for quantum systems and the related mathematical concepts. In-depth understanding of quantum properties of light and their experimental signatures, including photon sta- tistics and correlations. Knowledge of the theory of open systems and master equation description involving Lindblad superoperators. Understanding and modeling the role of coherence and interference in light propagati- on effects in resonant atomic media. Knowledge of cooperative effects in many-body systems: super- and subra-					
Course	s (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)	
V (4) + Module	R (2) e taugh	t in: German or English				
Metho ster, in	d of as format	sessment (type, scope, la ion on whether module ca	nguage — if other tha an be chosen to earn	an German, examina a bonus)	tion offered — if not every seme-	
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or 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. Assessment offered: In the semester in which the course is offered and in the subsequent semester						
Allocat	ion of	olaces				
Additional information						
Workload						
240 h						
Referre	ed to in	LPOI (examination regu	lations for teaching-o	degree programmes)		
Master's w	ith 1 majo	r Quantum Technology (2021)	JMU Würzburg •	generated 30-Mär-2024 • exa	am. reg. da- page 105 / 106	

Module appears in

Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Physics (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Mathematical Physics (2022)