

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

Examination regulations version: 2020
Responsible: Faculty of Physics and Astronomy

Learning Outcomes

German contents and learning outcome available but not translated yet.

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

- Die Absolventen bzw. Absolventinnen besitzen hohes Abstraktionsvermögen, analytisches Denken, hohe Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventen bzw. Absolventinnen verfügen über einen breiten Überblick über die Teilgebiete der Nanotechnologie und interdisziplinäre Zusammenhänge.
- Sie verfügen über vertiefte Kenntnisse der physikalischen und technischen Grundlagen der Nanotechnik sowie fundiertes Wissen über die theoretischen und experimentellen Methoden zur Erlangung neuer Erkenntnisse.
- Sie sind in der Lage, ihre Fähigkeiten und Kenntnisse in eigenen Projekten umzusetzen und verfügen über Kenntnisse des aktuellen Forschungsstandes in mindestens einem Spezialgebiet der Nanowissenschaften.
- Sie sind in der Lage, sich anhand von Primärliteratur, insbesondere in englischer Sprache, in den aktuellen Forschungsstand eines Spezialgebiets einzuarbeiten und physikalische und technische Methoden selbstständig auf konkrete Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten.
- Sie sind in der Lage, auch bei unvollständigen Informationen Probleme der Nanotechnik 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.
- Sie sind in der Lage, mit Fachvertretern auf dem aktuellen Stand der Forschung physikalische und technische Fragestellungen zu diskutieren und auch Nichtwissenschaftlern physikalische Fragen zu erläutern.
- Sie 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.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen verfügen über vertiefte Kenntnisse der physikalischen und technischen Grundlagen der Nanowissenschaften.
- Die Absolventinnen und Absolventen können ein fundiertes Wissen über die theoretischen und experimentellen Methoden zur Erlangung neuer Erkenntnisse abrufen.
- Die Absolventen bzw. Absolventinnen können auf einen breiten Überblick über das Gesamtgebiet der Nanowissenschaften zurückgreifen.
- Die Absolventen und Absolventinnen 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 Nanowissenschaften.
- 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 Nanostrukturwissenschaften 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 Nanostrukturwissenschaften.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind in der Lage, auch bei unvollständigen Informationen Probleme der Nanostrukturwissenschaften 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.

Abbreviations used

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

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

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

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

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

Conventions

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

Notes

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

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

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

In accordance with

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

ASPO2015

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

14-Nov-2019 (2019-58)

09-Jun-2021 (2021-65)

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

The subject is divided into

Abbreviation	Module title	ECTS credits	Method of grading	page
Compulsory Electives (60 ECTS credits)				
Subfield Nanotechnology (55 ECTS credits)				
Advanced Laboratory Course (9 ECTS credits)				
11-P-FM1-161-m01	Advanced Laboratory Course Master Part 1	3	B/NB	83
11-P-FM2-161-m01	Advanced Laboratory Course Master Part 2	3	B/NB	84
11-P-FM3-161-m01	Advanced Laboratory Course Master Part 3	3	B/NB	85
11-P-FM4-161-m01	Advanced Laboratory Course Master Part 4	3	B/NB	86
Advanced Seminar (5 ECTS credits)				
11-OSN-A-161-m01	Advanced Seminar Nanotechnology A	5	NUM	81
11-OSN-B-161-m01	Advanced Seminar Nanotechnology B	5	NUM	82
Focus Nanotechnology				
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	67
11-HPH-201-m01	Semiconductor Physics	6	NUM	69
11-QTR-201-m01	Quantum Transport	6	NUM	95
11-NOP-161-m01	Nano-Optics	6	NUM	77
11-SPI-161-m01	Spintronics	6	NUM	97
11-BSV-161-m01	Image and Signal Processing in Physics	6	NUM	36
11-PMM-161-m01	Physics of Advanced Materials	6	NUM	87
11-OHL-161-m01	Organic Semiconductors	6	NUM	79
o8-FU-SAM-161-m01	Sensor and Actor Materials - Functional Ceramics and Magnetic Particles	5	NUM	14
o8-PCM4-161-m01	Ultrafast spectroscopy and quantum-control	5	NUM	15
o8-FU-EEW-152-m01	Electrochemical Energy Storage and Conversion	5	NUM	11
o8-FU-MW-161-m01	Structure and Properties of Modern Materials: Experiments vs. Simulations	5	NUM	13
11-EXN5-161-m01	Current Topics in Nanotechnology	5	NUM	44
11-EXN6-161-m01	Current Topics in Nanotechnology	6	NUM	45
11-EXN7-161-m01	Current Topics in Nanotechnology	7	NUM	47
11-EXN8-161-m01	Current Topics in Nanotechnology	8	NUM	48
11-EXN6A-161-m01	Current Topics in Nanotechnology	6	NUM	46
11-CSFM-161-m01	Advanced Topics in Solid State Physics	6	NUM	38
11-CSNM-161-m01	Advanced Topics in Nanotechnology	6	NUM	40
11-CSPM-161-m01	Advanced Topics in Physics	6	NUM	41
11-FK2-201-m01	Solid State Physics 2	8	NUM	61
11-FKS-161-m01	Solid State Spectroscopy	6	NUM	63
11-TEFK-201-m01	Topological Effects in Solid State Physics	8	NUM	103
11-FFK-201-m01	Field Theory in Solid State Physics	8	NUM	59
11-AKTF-201-m01	Selected Topics of Theoretical Solid State Physics	6	NUM	28
11-MAG-161-m01	Magnetism	6	NUM	71
11-QM2-161-m01	Quantum Mechanics II	8	NUM	93
11-TFK-161-m01	Theoretical Solid State Physics	8	NUM	105
11-PTS-201-m01	Phenomenology and Theory of Superconductivity	6	NUM	89

11-QIC-201-m01	Advanced Theory of Quantum Computing and Quantum Information	6	NUM	91
11-MRI-171-m01	Advanced Magnetic Resonance Imaging	6	NUM	75
11-SSC-172-m01	Surface Science	6	NUM	101
11-FPA-161-m01	Visiting Research	10	NUM	65
11-EXP5-161-m01	Current Topics in Physik	5	NUM	50
11-EXP6-161-m01	Current Topics in Physik	6	NUM	51
11-EXP7-161-m01	Current Topics in Physik	7	NUM	55
11-EXP8-161-m01	Current Topics in Physik	8	NUM	56
11-EXP6A-161-m01	Current Topics in Physik	6	NUM	53
11-SPT-211-m01	Scanning Probe Technologies	6	NUM	99
11-EIM-211-m01	Electron and Ion Microscopy	6	NUM	42
Subfield Non-technical 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-I-BS-191-m01	Operating Systems	5	NUM	23
10-I=KI1-161-m01	Artificial Intelligence 1	5	NUM	17
02-EReWi-G-161-m01	Introduction to Law for Economists	5	NUM	7
02-N-P-Wo6-182-m01	Trade Mark Law	3	NUM	9
02-N-P-Wo7-182-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	57
11-EXZ6-161-m01	Additional Qualifications	6	NUM	58
11-EXNT6-161-m01	Non-technical Minor Subject	6	NUM	49
Thesis (60 ECTS credits)				
11-FS-N-161-m01	Professional Specialization Nanotechnology	15	B/NB	66
11-MP-N-161-m01	Scientific Methods and Project Management Nanotechnology	15	B/NB	74
11-MA-N-161-m01	Master Thesis Nanotechnology	30	NUM	73

Module title			Abbreviation
Introduction to Law for Economists			02-EReWi-G-161-m01
Module coordinator		Module offered by	
Dean of the Faculty of Law		Faculty of Law	
ECTS	Method of grading	Only after succ. compl. of module(s)	
5	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	undergraduate	--	
Contents			
This module provides an introduction to law. It deals with the creation of laws, types of laws, organization of the judiciary, legal sources, international law (Europe, UN), the German legal system (private law, public law, criminal law).			
Intended learning outcomes			
The student has knowledge of the national and international legal system, the formation and content as well as the dissolution and consequences of contracts, the formation of laws, the structure of legal systems.			
Courses (type, number of weekly contact hours, language — if other than German)			
V (3) + Ü (2)			
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)			
written examination (approx. 120 minutes) Assessment offered: Usually once a year, winter semester			
Allocation of places			
There are no restrictions with regard to available places for students of Rechtswissenschaft (Law) as well as Bachelor's students with the minor Privatrecht (Private Law). A total of 20 places will be allocated to students of other subjects. 10 of these will be allocated to students of the Master's degree programme Economics. Should the number of available places exceed the number of applications, the remaining places may be allocated to students of other subjects. Should there be more than 10 applications, the remaining places will be allocated as follows: 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			
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Workload			
150 h			
Teaching cycle			
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Referred to in LPO I (examination regulations for teaching-degree programmes)			
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Module appears in			
Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Quantum Technology (2021)			

Module title		Abbreviation
Commercial and Business Law for Economists		02-G&Hre-G-161-m01
Module coordinator		Module offered by
Dean of the Faculty of Law		Faculty of Law
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
This module provides an introduction to German and European corporate and commercial law.		
Intended learning outcomes		
The student has knowledge of company and commercial law, in particular of company forms, power of representation, liability, formation and dissolution of companies as well as the basics of the law of commercial transactions and commercial companies.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + Ü (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 120 minutes) Assessment offered: Usually once a year, summer semester		
Allocation of places		
There are no restrictions with regard to available places for students of Rechtswissenschaft (Law) as well as Bachelor's students with the minor Privatrecht (Private Law). A total of 20 places will be allocated to students of other subjects. 10 of these will be allocated to students of the Master's degree programme Economics. Should the number of available places exceed the number of applications, the remaining places may be allocated to students of other subjects. Should there be more than 10 applications, the remaining places will be allocated as follows: 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		
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Workload		
150 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Bachelor's degree (1 major) Computer Science (2017) Bachelor's degree (1 major) Computer Science (2019) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title		Abbreviation
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. compl. of module(s)
3	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
The lecture provides an overview of German and European trademark law. In addition to the basics of the concept and protection of trademarks under the German Trademark Act, the requirements and effects of the European Community Trademark under the Community Trademark Regulation will be discussed. Furthermore, special regulations of German trademark law are discussed, e.g. business names, geographical indications of source and the protection of Internet domains under trademark law.		
Intended learning outcomes		
Students will be able to analyze trademark law issues from the perspective of German and European law.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 120 minutes) or b) oral examination (approx. 15 minutes) Assessment offered: Usually once a year, summer semester		
Allocation of places		
max. 10 places. There are no restrictions with regard to available places for students of the degree programme Rechtswissenschaft (Law) pursuing the degree Erste Juristische Staatsprüfung (first state examination in law) as well as Bachelor's students with the minor Privatrecht (Private Law). A total of 10 places will be allocated to students of other subjects. Should there be more than 10 applications from students of other subjects, these places will be allocated as follows: Students applying after not having successfully completed assessment in the past two semesters will be given preferential consideration. The remaining places will be allocated by lot. A waiting list will be maintained and places re-allocated as they become available.		
Additional information		
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Workload		
90 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Bachelor's degree (1 major, 1 minor) Private Law (Minor, 2018) Bachelor's degree (1 major, 1 minor) Private Law (Minor, 2019) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title		Abbreviation
Copyright Law		02-N-P-W07-182-m01
Module coordinator		Module offered by
Dean of Studies Faculty of Law		Faculty of Law
ECTS	Method of grading	Only after succ. compl. of module(s)
2	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
In addition to the general basics of intellectual property law, the course will cover the protection of works under the German Copyright Act. In a further part of the course, design law as well as patent and utility model law will be examined.		
Intended learning outcomes		
Students have acquired basic knowledge of industrial property rights and copyright law. They will be able to classify problems from these areas in the context of German and European regulations.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 120 minutes) or b) oral examination (approx. 15 minutes) Assessment offered: Usually once a year, summer semester		
Allocation of places		
max. 10 places. There are no restrictions with regard to available places for students of the degree programme Rechtswissenschaft (Law) pursuing the degree Erste Juristische Staatsprüfung (first state examination in law) as well as Bachelor's students with the minor Privatrecht (Private Law). A total of 10 places will be allocated to students of other subjects. Should there be more than 10 applications from students of other subjects, these places will be allocated as follows: Students applying after not having successfully completed assessment in the past two semesters will be given preferential consideration. The remaining places will be allocated by lot. A waiting list will be maintained and places re-allocated as they become available.		
Additional information		
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Workload		
60 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Bachelor's degree (1 major, 1 minor) Private Law (Minor, 2018) Bachelor's degree (1 major, 1 minor) Private Law (Minor, 2019) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title			Abbreviation
Electrochemical Energy Storage and Conversion			o8-FU-EEW-152-mo1
Module coordinator		Module offered by	
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis	
ECTS	Method of grading	Only after succ. compl. of module(s)	
5	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	undergraduate	--	
Contents			
Chemistry and application of: battery systems (aqueous and non-aqueous systems such as lead, nickel cadmium and nickel metal hydride, sodium sulphur, sodium nickel chloride, lithium ion accumulators), electrochemical double layer capacitors, redox-flow batteries, fuel cell systems (AFC, PEMFC, DMFC, PAFC, SOFC), solar cells (Si, CIS, CIGS, GaAs, organic and dye solar cell), thermoelectric devices.			
Intended learning outcomes			
Students have developed a knowledge of electrochemical energy storage and conversion and are able to apply that knowledge to research problems.			
Courses (type, number of weekly contact hours, language — if other than German)			
V (2) + P (1) + E (1)			
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)			
a) assessment and b) Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical assignments (2 to 4 random examinations), weighted 7:3 Language of assessment: German and/or English Assessment offered: Once a year, summer semester			
Allocation of places			
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Additional information			
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Workload			
150 h			
Teaching cycle			
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Referred to in LPO I (examination regulations for teaching-degree programmes)			
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Module appears in			
Bachelor's degree (1 major) Nanostructure Technology (2015) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Quantum Technology (2021)			
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Master's degree (1 major) Quantum Technology (2021)

Module title			Abbreviation
Structure and Properties of Modern Materials: Experiments vs. Simulations			o8-FU-MW-161-m01
Module coordinator		Module offered by	
degree programme coordinator Funktionswerkstoffe (Functional Matrierials)		Chair of Chemical Technology of Material Synthesis	
ECTS	Method of grading	Only after succ. compl. of module(s)	
5	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	graduate	--	
Contents			
Material properties of metals and ceramics: correlation of structure/property relations through experiments and simulations.			
Intended learning outcomes			
Students gain an insight into the properties of modern materials: aerospace aluminium alloys and high-performance ceramics. They are introduced to measuring methods and calculation methods using numerical simulation. A special focus is on the relation between the micro/nanoscopic structure of materials and the resulting properties.			
Courses (type, number of weekly contact hours, language — if other than German)			
V (2) + S (1)			
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)			
a) talk (approx. 30 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes total) Language of assessment: German and/or English Assessment offered: Once a year, winter semester			
Allocation of places			
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Additional information			
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Workload			
150 h			
Teaching cycle			
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Referred to in LPO I (examination regulations for teaching-degree programmes)			
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Module appears in			
Master's degree (1 major) Physics (2016) 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's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021)			

Module title			Abbreviation
Sensor and Actor Materials - Functional Ceramics and Magnetic Particles			o8-FU-SAM-161-m01
Module coordinator		Module offered by	
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis	
ECTS	Method of grading	Only after succ. compl. of module(s)	
5	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	graduate	--	
Contents			
Fabrication, effects and applications of sensory and actuator materials such as piezoelectrics, shape memory materials and magnetostrictive materials. Electrorheological and magnetorheological fluids, magnetofluids.			
Intended learning outcomes			
Students have developed fundamental knowledge in the area of sensory and actuator materials.			
Courses (type, number of weekly contact hours, language — if other than German)			
V (2) + P (2)			
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)			
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) Language of assessment: German and/or English Assessment offered: Once a year, summer semester P: creditable for bonus			
Allocation of places			
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Additional information			
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Workload			
150 h			
Teaching cycle			
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Referred to in LPO I (examination regulations for teaching-degree programmes)			
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Module appears in			
Master's degree (1 major) Physics (2016) 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's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)			

Module title		Abbreviation
Ultrafast spectroscopy and quantum-control		o8-PCM4-161-mo1
Module coordinator		Module offered by
lecturer of the seminar "Nanoskalige Materialien"		Institute of Physical and Theoretical Chemistry
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Prior completion of modules o8-PCM1a and o8-PCM1b recommended.
Contents		
This module discusses advanced topics in ultrafast spectroscopy and quantum control. It focuses on ultrashort laser pulses, time-resolved laser spectroscopy and coherent control.		
Intended learning outcomes		
Students are able to describe the generation of ultrashort laser pulses and to characterise them. They can explain the theory of time-resolved laser spectroscopy and name experimental methods. They can describe the principles and applications of quantum control.		
Courses (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (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)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes) Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
150 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 15 / 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) 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 (2024)
 Master's degree (1 major) Mathematics (2024)

Module title		Abbreviation
Artificial Intelligence 1		10-I=KI1-161-m01
Module coordinator		Module offered by
holder of the Chair of Computer Science VI		Institute of Computer Science
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Intelligent agents, uninformed and heuristic search, constraint problem solving, search with partial information, propositional and predicate logic and inference, knowledge representation.		
Intended learning outcomes		
The students possess theoretical and practical knowledge about artificial intelligence in the area of agents, search and logic and are able to assess possible applications.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2)		
Method of assessment (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. 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 (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus		
Allocation of places		
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Additional information		
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,IS,HCI		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 17 / 106

Master's degree (1 major) Information Systems (2019)
 Master's degree (1 major) Nanotechnology (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
Analysis and Design of Programs		10-I=PA-161-m01
Module coordinator		Module offered by
holder of the Chair of Computer Science II		Institute of Computer Science
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Program analysis, model creation in software engineering, program quality, test of programs, process models.		
Intended learning outcomes		
The students are able to analyse programs, to use testing frameworks and metrics as well as to judge program quality.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2)		
Method of assessment (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. 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 (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus		
Allocation of places		
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Additional information		
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IS,ES,GE		
Workload		
150 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	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
Advanced Programming		10-I-APR-172-m01
Module coordinator		Module offered by
holder of the Chair of Computer Science II		Institute of Computer Science
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code a sensible structure. Also, further topics in the areas of software security and parallel programming are discussed.		
Intended learning outcomes		
Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2)		
Method of assessment (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. 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 (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus		
Allocation of places		
--		
Additional information		
--		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
§ 22 II Nr. 3 b)		
Module appears in		
Bachelor's degree (1 major) Computer Science (2017) Bachelor's degree (1 major) Computer Science (2019) Module studies (Bachelor) Computer Science (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) Bachelor's degree (1 major) Business Information Systems (2020)		
Master's with 1 major Nanostructure Technology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 21 / 106

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

Module title		Abbreviation
Operating Systems		10-I-BS-191-m01
Module coordinator		Module offered by
holder of the Chair of Computer Science II		Institute of Computer Science
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
Introduction to computer systems, development of operating systems, architecture principles, interrupt processing in operating systems, processes and threads, CPU scheduling, synchronisation and communication, memory management, device and file management, operating system virtualisation.		
Intended learning outcomes		
The students possess knowledge and practical skills in building and using essential parts of operating systems.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2) Module taught in: 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. 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 (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus		
Allocation of places		
--		
Additional information		
--		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Bachelor's degree (1 major) Computer Science (2019) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Bachelor's degree (1 major) Business Information Systems (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Master's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Business Information Systems (2021) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 23 / 106

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

Module title		Abbreviation
Discrete Mathematics		10-M=VDIM-161-m01
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Advanced methods and results in a selected field of discrete mathematics (e. g. coding theory, cryptography, graph theory or combinatorics)		
Recommended previous knowledge: Basic knowledge of the contents of the module "Introduction to Discrete Mathematics" is required.		
Intended learning outcomes		
The student is acquainted with advanced results in a selected topic in discrete mathematics.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + Ü (1) Module taught in: German and/or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 60 to 90 minutes, usually chosen) or b) oral examination of one candidate each (approx. 15 minutes) or c) oral examination in groups (groups of 2, approx. 10 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus		
Allocation of places		
--		
Additional information		
--		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanotechnology (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 25 / 106

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

Module title		Abbreviation
Advanced Analysis		10-M-VAN-152-m01
Module coordinator		Module offered by
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
ECTS	Method of grading	Only after succ. compl. of module(s)
7	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
Continuation of analysis in several variables, integration theorems.		
Intended learning outcomes		
The student is acquainted with advanced topics in analysis. Taking the example of the Lebesgue integral, he or she is able to understand the construction of a complex mathematical concept.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (4) + Ü (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus		
Allocation of places		
--		
Additional information		
--		
Workload		
210 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) 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) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Mathematics (2023)		

Module title		Abbreviation
Selected Topics of Theoretical Solid State Physics		11-AKTF-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
In this lecture, selected topics of condensed matter theory are addressed. We intend to present new developments to bring the students in touch with actual research topics. Possible subjects are many-body localization and dynamic quantum matter.		
Intended learning outcomes		
The students learn how to describe condensed matter systems in presence of disorder and interactions from a theoretical point of view. This happens on the basis of analytical and numerical methods. Therefore, we envisage a smooth crossover of these students to the next step of becoming a researcher.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Nanotechnology (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 with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 28 / 106

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

Module title		Abbreviation
Astrophysics		11-AP-152-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
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 medium, molecular clouds, structure of the milky way, the local universe, the expanding universe, galaxies, active galactic nuclei, large-scale structures, cosmology.		
Intended learning outcomes		
The students are familiar with the modern world view of Astrophysics. They know methods and tools for astrophysical observations and evaluations. They are able to use these methods to plan and analyse own observations. They are familiar with the physics and development of the main astrophysical objects such as stars and galaxies.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + R (2) Module taught in: German or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
§ 22 II Nr. 1 h) § 22 II Nr. 2 f) § 22 II Nr. 3 f)		
Module appears in		
Bachelor's degree (1 major) Physics (2015)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 30 / 106

Bachelor's degree (1 major) Mathematical Physics (2015)
 Bachelor's degree (1 major) Aerospace Computer Science (2015)
 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's degree (1 major) Mathematical Physics (2016)
 Master's degree (1 major) Nanotechnology (2016)
 Bachelor's 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) Nanotechnology (2020)
 Bachelor's degree (1 major) Physics (2020)
 Bachelor's degree (1 major) Mathematical Physics (2020)
 Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020)
 Bachelor's 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's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Methods of Observational Astronomy			11-ASM-161-m01
Module coordinator		Module offered by	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	Method of grading	Only after succ. compl. of module(s)	
6	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	graduate	--	
Contents			
Methods of observational astronomy across the electromagnetic spectrum. Evaluation of observational data from radio, optical, X-ray and gamma-ray telescopes.			
Intended learning outcomes			
Overview of the methods used in observational astronomy in various parts of the electromagnetic spectrum (radio, optical, X-ray and gamma-ray energies). Knowledge of principles and applications of these methods and ability to conduct astronomical observations.			
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)			
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester			
Allocation of places			
--			
Additional information			
--			
Workload			
180 h			
Teaching cycle			
--			
Referred to in LPO I (examination regulations for teaching-degree programmes)			
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Module appears in			
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)			
Master's with 1 major Nanostructure Technology (2020)		JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	
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Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
 Master's degree (1 major) Computational Mathematics (2019)
 Master's degree (1 major) Mathematics (2019)
 Master's degree (1 major) Nanotechnology (2020)
 Master's degree (1 major) Physics (2020)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Master's degree (1 major) Quantum Technology (2021)
 Master's degree (1 major) Computational Mathematics (2022)
 Master's degree (1 major) Mathematics (2022)
 exchange program Physics (2023)
 Master's degree (1 major) Computational Mathematics (2024)
 Master's degree (1 major) Mathematics (2024)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title		Abbreviation
Introduction to Space Physics		11-ASP-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
1. Overview 2. Dynamics of charged particles in magnetic and electric fields 3. Elements of space physics 4. The sun and heliosphere 5. Acceleration and transport of energetic particles in the heliosphere 6. Instruments to measure energetic particles in extraterrestrial space		
Intended learning outcomes		
The students acquire basic knowledge of Space Physics, in particular regarding the characterisation of the dynamics of charged particles in space and the heliosphere. They know relevant parameters and theoretical concepts and corresponding measuring methods.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016)		
Master's with 1 major Nanostructure Technology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 34 / 106

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

Module title		Abbreviation
Image and Signal Processing in Physics		11-BSV-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Periodic and aperiodic signals; principles of discrete and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parseval theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.		
Intended learning outcomes		
The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2) Module taught in: German or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanotechnik - 2020	page 36 / 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) Nanotechnology (2020)
 Master's degree (1 major) Physics (2020)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Master's degree (1 major) Quantum Technology (2021)
 Master's degree (1 major) Computational Mathematics (2022)
 Master's degree (1 major) Functional Materials (2022)
 Master's degree (1 major) Mathematics (2022)
 exchange program Physics (2023)
 Master's degree (1 major) Computational Mathematics (2024)
 Master's degree (1 major) Mathematics (2024)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
 Master's degree (1 major) Functional Materials (2025)

Module title		Abbreviation
Advanced Topics in Solid State Physics		11-CSFM-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
This module will enable the lecturers of Condensed Matter Physics to teach advanced courses on topics not covered in any of the other modules. These topics may relate either to recent research developments or to subjects not included in the regular curriculum.		
Intended learning outcomes		
The students advance their knowledge and understanding of an advanced topic of Condensed Matter Physics and acquire insights into the connections between research and teaching.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (2020) Master's degree (1 major) Physics (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 38 / 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 studies (Master) Quantum Technology (2021)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title		Abbreviation
Advanced Topics in Nanotechnology Technology		11-CSNM-161-mo1
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
This module allows lecturers of the nanotechnology 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 advance their knowledge and understanding of an advanced topic of nanotechnology technology and acquire insights into the connections between research and teaching.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology Technology (2016) Master's degree (1 major) Nanotechnology Technology (2020)		

Module title		Abbreviation
Advanced Topics in Physics		11-CSPM-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
This module will enable lecturers of Physics to teach advanced courses on topics not covered in any of the other modules. These topics may relate either to recent research developments or to subjects not included in the regular curriculum.		
Intended learning outcomes		
The students advance their knowledge and understanding of an advanced topic of nanotechnology and acquire insights into the connections between research and teaching.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)		

Module title		Abbreviation
Electron and Ion Microscopy		11-EIM-211-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Theoretical Foundations. Electron and ion sources, optics of charged particles, interaction of matter with electrons and charged particles, detectors, measurement principles: SEM, STEM, TEM, sample preparation, advanced contrast mechanisms: EBSD, EELS, EDS, cathodoluminescence.		
Intended learning outcomes		
The student has specific and immersed knowledge in electron and ion microscopy. He/she knows the theoretical and instrumental basics and principles of detectors and contrast mechanisms. He/she knows different modi of electron microscopy and their applications. He/she knows ongoing developments in this field.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
Teaching cycle: annually, after announcement		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Functional Materials (2022) exchange program Physics (2023)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 42 / 106

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

Module title		Abbreviation
Current Topics in Nanotechnology Technology		11-EXN5-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + R (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 90 to 120 minutes) 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		
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Additional information		
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Workload		
150 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology Technology (2016) Master's degree (1 major) Nanotechnology Technology (2020)		

Module title		Abbreviation
Current Topics in Nanotechnology Technology		11-EXN6-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology Technology (2016) Master's degree (1 major) Nanotechnology Technology (2020)		

Module title		Abbreviation
Current Topics in Nanotechnology Technology		11-EXN6A-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Current Topics in Nanotechnology Technology		11-EXN7-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
7	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
210 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology Technology (2016) Master's degree (1 major) Nanotechnology Technology (2020)		

Module title		Abbreviation
Current Topics in Nanotechnology Technology		11-EXN8-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (4) + R (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 90 to 120 minutes) 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		
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Additional information		
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Workload		
240 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology Technology (2016) Master's degree (1 major) Nanotechnology Technology (2020)		

Module title		Abbreviation
Non-technical Minor Subject		11-EXNT6-161-mo1
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Non-technical minor. Crediting for academic achievements, e.g. from university change or study abroad		
Intended learning outcomes		
The students have advanced competencies on the Master's level which correspond to the requirements of a module in the field of a non-technical minor (mathematics, chemistry, informatics, law, business sciences...).		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title		Abbreviation
Current Topics in Physik		11-EXP5-161-mo1
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + R (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 90 to 120 minutes) 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		
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Additional information		
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Workload		
150 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)		

Module title		Abbreviation
Current Topics in Physik		11-EXP6-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in experimental or theoretical physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (2020) Master's degree (1 major) Physics (2020)		
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Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
 Master's degree (1 major) Quantum Technology (2021)
 Module studies (Master) Quantum Technology (2021)
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title		Abbreviation
Current Topics in Physik		11-EXP6A-161-mo1
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics in Experimental or Theoretical Physics. Credited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (2020) Master's degree (1 major) Physics (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 53 / 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 studies (Master) Quantum Technology (2021)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title		Abbreviation
Current Topics in Physik		11-EXP7-161-mo1
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
7	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics of Experimental and Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
210 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)		

Module title		Abbreviation
Current Topics in Physik		11-EXP8-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Current topics of Experimental and Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Master's programme of Nanotechnology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (4) + R (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 90 to 120 minutes) 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		
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Additional information		
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Workload		
240 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021) Module studies (Master) Quantum Technology (2021)		

Module title		Abbreviation
Additional Qualifications		11-EXZ5-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Additional skills for engineers. Accredited academic achievements, e.g. in case of change of university or study abroad.		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of the Master's degree programme of Nanotechnology. They have qualifying knowledge for an occupation in the industry or industrial research.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (2) + R (2)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 90 to 120 minutes) 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		
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Additional information		
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Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title		Abbreviation
Additional Qualifications		11-EXZ6-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
Additional skills for engineers. Accredited academic achievements, e.g. in case of change of university or study abroad		
Intended learning outcomes		
The students have advanced competencies corresponding to the requirements of a module of the Master's degree programme of Nanotechnology. They have qualifying knowledge for an occupation in the industry or industrial research.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
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		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Quantum Technology (2021)		

Module title			Abbreviation
Field Theory in Solid State Physics			11-FFK-201-m01
Module coordinator		Module offered by	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	Method of grading	Only after succ. compl. of module(s)	
8	numerical grade	--	
Duration	Module level	Other prerequisites	
1 semester	graduate	--	
Contents			
<p>This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions</p> <p>An outline could be:</p> <ol style="list-style-type: none">1. Single-particle Green's function2. Review of second quantization3. Diagrammatic method using many particle Green's functions at temperature $T=0$4. Diagrammatic method for finite T5. Landau theory of Fermi liquids6. Superconductivity7. 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 properties of Fermi liquids (and bosonic systems) beyond the one-particle picture. Acquisition of methods which are essential for the understanding the effects of interactions, including superconductivity and the Kondo effect.			
Courses (type, number of weekly contact hours, language — if other than German)			
V (4) + R (2)			
Module taught in: German or English			
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)			
<p>a) written examination (approx. 90 to 120 minutes) or</p> <p>b) oral examination of one candidate each (approx. 30 minutes) or</p> <p>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</p> <p>d) project report (approx. 8 to 10 pages) or</p> <p>e) presentation/talk (approx. 30 minutes).</p> <p>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.</p> <p>Language of assessment: German and/or English</p> <p>Assessment offered: In the semester in which the course is offered and in the subsequent semester</p>			
Allocation of places			
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Additional information			
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Workload			
240 h			
Teaching cycle			
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Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module appears in

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

Module title		Abbreviation
Solid State Physics 2		11-FK2-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.
Contents		
<ol style="list-style-type: none"> 1. Electrons in a periodic potential - the band structure <ol style="list-style-type: none"> a. Electrical and thermal transport b. Bloch theorem c. Electrons 2. Semi-classical models of dynamic processes <ol style="list-style-type: none"> a. Electrical transport in partially and completely filled bands b. Fermi surfaces; measurement techniques c. Electrical transport in external magnetic fields d. Boltzmann-equations of transport 3. The dielectric function and ferroelectrics <ol style="list-style-type: none"> a. Macroscopic electrodynamics and microscopic theory b. Polarizability of solids, of lattices, of valence electrons and quasi-free electrons; optical phonons, polaritons, plasmons, inter-band transitions, Wannier-Mott excitons c. Ferromagnetism 4. Semiconductors <ol style="list-style-type: none"> a. Characteristics b. Intrinsic semiconductors c. Doped semiconductors d. Physics and applications of p-n junctions e. Heterostructures 5. Magnetism <ol style="list-style-type: none"> a. Atomic dia- and paramagnetism b. Dia- and paramagnetism in metals c. Ferromagnetism 6. Superconductivity <ol style="list-style-type: none"> a. Phenomena b. Models of superconductivity c. Tunnel experiments und applications 		
Intended learning outcomes		
Knowledge of effects, concepts and models in advanced solid state physics. Familiarity with the theoretical principles and with applications of experimental methods.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (4) + R (2) Module taught in: German or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<ol style="list-style-type: none"> 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). <p>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</p>		
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of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: German and/or English

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

Allocation of places

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Additional information

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Workload

240 h

Teaching cycle

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

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Module appears in

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

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

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

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

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

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

Master's degree (1 major) Functional Materials (2022)

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

exchange program Physics (2023)

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

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

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

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

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

Module title		Abbreviation
Solid State Spectroscopy		11-FKS-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Single- and many-particle pictures of electrons in solids, light-matter interaction, optical spectroscopy, electron microscopy, X-ray spectroscopy.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of solid-state spectroscopy. They know different types of spectroscopy and their fields of application. They understand the theoretical principles and the current developments in research.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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 with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 63 / 106

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

Module title		Abbreviation
Visiting Research		11-FPA-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--
Duration	Module level	Other prerequisites
	graduate	Approval from examination committee required.
Contents		
Independent work on a current research topic of Experimental and Theoretical Physics. Implementation of scientific experiments including analysis and documentation of the results, especially in the context of research visits to other universities or research institutes.		
Intended learning outcomes		
The students are able to independently work on a current research area of Experimental or Theoretical Physics, to conduct and analyse scientific experiments and to document the results.		
Courses (type, number of weekly contact hours, language — if other than German)		
R (o)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
project report (10 to 20 pages) Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
300 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (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 teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)		

Module title		Abbreviation
Professional Specialization Nanotechnology		11-FS-N-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
15	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Introduction to current experimental or theoretical questions of a subdiscipline of nanotechnology with special relevance to the planned topic of the Master's thesis. Summary of the required fundamental topics in a seminar presentation.		
Intended learning outcomes		
The students have advanced scientific knowledge of the principles of a current experimental, theoretical or engineering subdiscipline of nanotechnology with special relevance to the intended topic of the Master's thesis and are able to summarise their knowledge in an oral presentation.		
Courses (type, number of weekly contact hours, language — if other than German)		
S (4) 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)		
talk with discussion (30 to 45 minutes) Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
450 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Optical Properties of Semiconductor Nanostructures		11-HNS-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Semiconductor nanostructures are frequently referred to as "artificial materials". In contrast to atoms, molecules or macroscopic crystals, their electronic, optical and magnetic properties can be systematically tailored by changing their size. The lecture addresses technological challenges in the preparation of semiconductor nanostructures of varying dimensions (2D, 1D, 0D). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.		
Intended learning outcomes		
The students know the theoretical principles and characteristics of semiconductor nanostructures. They have knowledge of the technological methods to fabricate such structures, and of their applications to novel photonic devices. They are able to apply their knowledge to problems in this field of research.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 67 / 106

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

Module title		Abbreviation
Semiconductor Physics		11-HPH-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
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 electronic properties of monolithic semiconductors. It then turns to examining semiconductor heterostructures, and studies how these can be used to modify and design 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)		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 69 / 106

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

Module title		Abbreviation
Magnetism		11-MAG-161-mo1
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain structure, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo effect.		
Intended learning outcomes		
The students know basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas; they have competencies in independently working on problems of these areas; they are able to evaluate the accuracy of observations and analyses.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 71 / 106

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

Module title		Abbreviation
Master Thesis Nanotechnology		11-MA-N-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
30	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Mostly independent processing of an experimental, theoretical or engineering task in the field of nanotechnology, especially according to known procedures and scientific aspects; writing of the thesis.		
Intended learning outcomes		
The students are able to independently work on an experimental, theoretical and engineering task from nanotechnology, especially in accordance with known methods and scientific aspects and to summarise their results in a final paper.		
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 semester, 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		
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Additional information		
Time to complete: 6 months.		
Workload		
900 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Scientific Methods and Project Management Nanotechnology		11-MP-N-161-m01
Module coordinator		Module offered by
chairperson of examination committee		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
15	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Introduction to the methods of scientific work, taking into account methods of project planning. Application to theoretical, experimental or engineering questions of nanotechnology. Writing of a scientific project plan for the planned Master's thesis.		
Intended learning outcomes		
The students have knowledge of the scientific methods, the methodological work and the methods of project planning of a current experimental, theoretical or engineering subdiscipline of nanotechnology with special relevance to the intended topic of the Master's thesis and are able to develop a project plan for the Master's thesis, to plan the required work and to summarise their knowledge in an oral presentation.		
Courses (type, number of weekly contact hours, language — if other than German)		
R (4) 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)		
talk with discussion (30 to 45 minutes) Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
450 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Advanced Magnetic Resonance Imaging		11-MRI-171-mo1
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>Nuclear magnetic resonance (NMR) is a quantum mechanical phenomenon that, through magnetic resonance imaging (MRI), has played a major role in the revolution of medical imaging over the last 30 years. Based on the fundamental principles of nuclear magnetic resonance (resonance principle, relaxation times, chemical shift) this course covers:</p> <ol style="list-style-type: none"> 1) the NMR signal theory and signal evolution (Bloch equations), 2) the principles of spatial encoding, magnetic resonance imaging (MRI) and corresponding imaging sequences and measurement parameters, 3) the concept of k-space and Fourier imaging, and 4) the physical, methodological and technical possibilities and limits of MRI. As a last point, exemplary applications in fields of MRI of biomedical research, clinical imaging and non-destructive testing are introduced. 		
Intended learning outcomes		
The students have advanced knowledge of the mathematical-theoretical and physical principles of modern imaging magnetic resonance, image generation and processing. They gain a broad overview of the field of modern MRI and its interdisciplinary contexts and applications.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: 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)		
<ol style="list-style-type: none"> 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) <p>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.</p> <p>Language of assessment: German and/or English</p> <p>Assessment offered: In the semester in which the course is offered and in the subsequent semester</p>		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in

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

Module title		Abbreviation
Nano-Optics		11-NOP-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical microscopy are discussed. In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in 2D, 1D and 0 dimensions are introduced and discussed in detail. This finally leads to the concept of optical antennas.		
Intended learning outcomes		
The students have specific and advanced knowledge in the field of nano-optics. They are familiar with the theoretical principles and application areas of nano-optics and with current developments in this field.		
Courses (type, number of weekly contact hours, language — if other than German)		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 77 / 106

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

Module title		Abbreviation
Organic Semiconductors		11-OHL-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Fundamentals of organic semiconductors, molecular and polymer electronics and sensor technology, applications.		
Intended learning outcomes		
The students have advanced knowledge of organic semiconductors.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanotechnik - 2020	page 79 / 106

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

Module title		Abbreviation
Advanced Seminar Nanotechnology A		11-OSN-A-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Seminar on current issues in Theoretical or Experimental Physics.		
Intended learning outcomes		
The students have advanced knowledge of a current specialist field of Experimental or Theoretical Physics. They are able to extract knowledge from professional publications and to summarise this knowledge and present it to a professional audience.		
Courses (type, number of weekly contact hours, language — if other than German)		
S (2) Module taught in: German or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
talk with discussion (30 to 45 minutes) Language of assessment: German and/or English		
Allocation of places		
--		
Additional information		
--		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Advanced Seminar Nanotechnology B		11-OSN-B-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Seminar on current issues in Theoretical or Experimental Physics.		
Intended learning outcomes		
The students have advanced knowledge of a current specialist field of Experimental or Theoretical Physics. They are able to extract knowledge from professional publications and to summarise this knowledge and present it to a professional audience.		
Courses (type, number of weekly contact hours, language — if other than German)		
S (2) Module taught in: German or English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
talk with discussion (30 to 45 minutes) Language of assessment: German and/or English		
Allocation of places		
--		
Additional information		
--		
Workload		
150 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020)		

Module title		Abbreviation
Advanced Laboratory Course Master Part 1		11-P-FM1-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Preparation and safety briefing.
Contents		
Principles of Nuclear, Atomic and Molecular Physics, experiments on cryogenic temperatures and correlated systems, properties of solids, surfaces and interfaces. Experiments on the following topics: X-rays - nuclear magnetic resonance (NMR) - quantum Hall effect - optical pumping and spectroscopy in the field of optics - Hall effect - superconductivity - laser - solid-state optics		
Intended learning outcomes		
Knowledge of conducting experiments, analysing and documenting experimental results, basic knowledge of issuing scientific publications, application of modern evaluation systems. The students are familiar with modern experimental methods. They are able to work on a task on the basis of publications, to conduct and evaluate an experiment and to present and discuss their results in a scientific publication.		
Courses (type, number of weekly contact hours, language — if other than German)		
P (3)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
practical examination Students must successfully prepare, perform, document (lab notebook) and evaluate (in the form of a scientific publication) an experiment to be considered to have successfully completed this experiment. Students must successfully complete two experiments to be considered to have successfully completed this module. Detailed regulations are laid down in the respective module description. Language of assessment: German and/or English		
Allocation of places		
--		
Additional information		
--		
Workload		
90 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (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 coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Preparation and safety briefing.
Contents		
Principles of Nuclear, Atomic and Molecular Physics, experiments on cryogenic temperatures and correlated systems, properties of solids, surfaces and interfaces. Experiments on the following topics: X-rays - nuclear magnetic resonance (NMR) - quantum Hall effect - optical pumping and spectroscopy in the field of optics - Hall effect - superconductivity - laser - solid-state optics		
Intended learning outcomes		
Knowledge of conducting experiments, analysing and documenting experimental results, basic knowledge of issuing scientific publications, application of modern evaluation systems. The students are familiar with modern experimental methods. They are able to work on a task on the basis of publications, to conduct and evaluate an experiment and to present and discuss their results in a scientific publication.		
Courses (type, number of weekly contact hours, language — if other than German)		
P (3)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
practical examination Students must successfully prepare, perform, document (lab notebook) and evaluate (in the form of a scientific publication) an experiment to be considered to have successfully completed this experiment. Students must successfully complete two experiments to be considered to have successfully completed this module. Detailed regulations are laid down in the respective module description. Language of assessment: German and/or English		
Allocation of places		
--		
Additional information		
--		
Workload		
90 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (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
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Preparation and safety briefing.
Contents		
Principles of Nuclear, Atomic and Molecular Physics, experiments on cryogenic temperatures and correlated systems, properties of solids, surfaces and interfaces. Experiments on the following topics: X-rays - nuclear magnetic resonance (NMR) - quantum Hall effect - optical pumping and spectroscopy in the field of optics - Hall effect - superconductivity - laser - solid-state optics		
Intended learning outcomes		
Knowledge of conducting experiments, analysing and documenting experimental results, basic knowledge of issuing scientific publications, application of modern evaluation systems. The students are familiar with modern experimental methods. They are able to work on a task on the basis of publications, to conduct and evaluate an experiment and to present and discuss their results in a scientific publication.		
Courses (type, number of weekly contact hours, language — if other than German)		
P (3)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
practical examination Students must successfully prepare, perform, document (lab notebook) and evaluate (in the form of a scientific publication) an experiment to be considered to have successfully completed this experiment. Students must successfully complete two experiments to be considered to have successfully completed this module. Detailed regulations are laid down in the respective module description. Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
90 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (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
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
3	(not) successfully completed	--
Duration	Module level	Other prerequisites
1 semester	graduate	Preparation and safety briefing.
Contents		
Principles of Nuclear, Atomic and Molecular Physics, experiments on cryogenic temperatures and correlated systems, properties of solids, surfaces and interfaces. Experiments on the following topics: X-rays - nuclear magnetic resonance (NMR) - quantum Hall effect - optical pumping and spectroscopy in the field of optics - Hall effect - superconductivity - laser - solid-state optics		
Intended learning outcomes		
Knowledge of conducting experiments, analysing and documenting experimental results, basic knowledge of issuing scientific publications, application of modern evaluation systems. The students are familiar with modern experimental methods. They are able to work on a task on the basis of publications, to conduct and evaluate an experiment and to present and discuss their results in a scientific publication.		
Courses (type, number of weekly contact hours, language — if other than German)		
P (3)		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
practical examination Students must successfully prepare, perform, document (lab notebook) and evaluate (in the form of a scientific publication) an experiment to be considered to have successfully completed this experiment. Students must successfully complete two experiments to be considered to have successfully completed this module. Detailed regulations are laid down in the respective module description. Language of assessment: German and/or English		
Allocation of places		
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Additional information		
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Workload		
90 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
--		
Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021) exchange program Physics (2023)		

Module title		Abbreviation
Physics of Advanced Materials		11-PMM-161-mo1
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.		
Intended learning outcomes		
The students know the properties and characterization methods of some modern materials.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 87 / 106

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

Module title		Abbreviation
Phenomenology and Theory of Superconductivity		11-PTS-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics and Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
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. Discussion of current research topics and perspective on room-temperature superconductivity.		
Intended learning outcomes		
Acquisition of basic knowledge about superconductivity as a macroscopic quantum phenomenon. Profound understanding of unconventional superconductivity and its interplay with magnetism in the context of current research. Knowledge of BCS mean-field theory, the quantum-field theory methods necessary to extend BCS theory, as well as the Meissner effect and the Higgs mechanism. Basic understanding of unconventional superconductors and their fascinating connection with competing magnetic phases.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
--		

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

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Module appears in

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

Module title		Abbreviation
Advanced Theory of Quantum Computing and Quantum Information		11-QIC-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
1. Brief summary of classical information theory 2. Quantum theory seen from the perspective of information theory 3. Composite systems and the Schmidt decomposition 4. Entanglement measures 5. Quantum operations, POVMs, and the theorems of Kraus and Stinespring 6. Quantum gates and quantum computers 7. Elements of the theory of decoherence		
Intended learning outcomes		
Comprehensive understanding of quantum states and identity matrix beyond the usual textbook interpretation. Knowledge of handling tensor products and dealing with quantum effects in multipartite quantum systems. In-depth understanding of the phenomenon of entanglement. Knowledge of the fundamental mathematical concepts of quantum information theory. Ability to assess the limitations of quantum computing arising from decoherence.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
180 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in

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

Module title		Abbreviation
Quantum Mechanics II		11-QM2-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	undergraduate	--
Contents		
<p>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:</p> <p>for QM:</p> <ol style="list-style-type: none"> 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		
<p>The students acquire in-depth knowledge of advanced quantum mechanics. This knowledge is highly relevant to most of the theoretical Master's degree courses in Astrophysics, Particle Physics and Condensed Matter Physics. The completion of this course is highly recommended.</p>		
Courses (type, number of weekly contact hours, language — if other than German)		
<p>V (4) + R (2) Module taught in: German or English</p>		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 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).</p> <p>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.</p> <p>Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester</p>		
Allocation of places		
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Additional information		
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Workload
240 h
Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (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) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title		Abbreviation
Quantum Transport		11-QTR-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>The lecture addresses the fundamental transport phenomena of electrons in solids where Electron-electron interaction 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 by actual research results.</p>		
Intended learning outcomes		
Working knowledge of basic transport experiments, its analysis and its interpretation which enables the student to discuss results critical.		
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)		
<p>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).</p> <p>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.</p> <p>Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester</p>		
Allocation of places		
--		
Additional information		
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Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2020)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 95 / 106

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

Module title		Abbreviation
Spintronics		11-SPI-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
This lecture covers the basic principles of spin transport, with a particular emphasis on the phenomena of giant magnetoresistance and tunnel magnetoresistance. As a last point, we discuss new phenomena from the field of spin dynamics and current-induced spin phenomena.		
Intended learning outcomes		
The students know the basic principles of spin transport models and the applications of spin transport in information technology. They have gained an overview of current findings in this field (giant magnetoresistance, tunnel magnetoresistance).		
Courses (type, number of weekly contact hours, language — if other than German)		
V (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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
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) Nanotechnology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanotechnik - 2020	page 97 / 106

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

Module title		Abbreviation
Scanning Probe Technologies		11-SPT-211-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
Basic theoretical principles of scanning force, tunneling, and near-field optical microscopy; basic principles of surface science; tip-sample interactions; design principles and material considerations; fundamentals of control engineering; measurement modes, e.g., contact and non-contact, Kelvin probe, friction force microscopy, etc.; basic principles of processing and presenting microscopy data; measurement techniques and their application: lock-in, phase-lock loop, etc.		
Intended learning outcomes		
Student acquires specific knowledge in scanning probe microscopy. He/she knows the basic theoretical principles, is aware of basic design principles, knows pros and cons of various materials, and is familiar of measurement modes, contrast mechanisms, and their application. He/she is aware of recent development in the field.		
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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
Teaching cycle: annually, after announcement		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Nanotechnology (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Technology (2021)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 99 / 106

exchange program Physics (2023)

Module title		Abbreviation
Surface Science		11-SSC-172-m01
Module coordinator		Module offered by
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
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.		
Intended learning outcomes		
The students have gained an overview of the diverse aspects of surface physics and especially know the causes and contexts of physical peculiarities of surfaces and interfaces. Additionally, they know the most important experimental techniques and their specific application possibilities in the context of surface physics.		
Courses (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: English		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
--		
Additional information		
--		
Workload		
180 h		
Teaching cycle		
--		
Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanotechnology (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)		
Master's with 1 major Nanotechnology (2020)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Nanostrukturtechnik - 2020	page 101 / 106

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

Module title		Abbreviation
Topological Effects in Solid State Physics		11-TEFK-201-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
1. Geometric phase in quantum systems 2. Mathematical basics of topology 3. Time-reversal symmetry 4. Hall conductance and Chern numbers 5. Bulk-boundary correspondence 6. Graphene (as a topological insulator) 7. Quantum Spin Hall insulators 8. Z ₂ invariants 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)		
a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester		
Allocation of places		
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Additional information		
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Workload		
240 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)		
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Module appears in

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

Module title		Abbreviation
Theoretical Solid State Physics		11-TFK-161-m01
Module coordinator		Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--
Duration	Module level	Other prerequisites
1 semester	graduate	--
Contents		
<p>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).</p> <p>A possible syllabus may be:</p> <ol style="list-style-type: none"> 1 Band structure (Sommerfeld theory of metals, Bloch theorem, k.p approach and effective Hamiltonians for topological insulators (TIs), bulk-surface correspondence, general properties of TIs) 2 Electron-electron interactions in solids (path integral method for weakly interacting fermions, mean field theory, random phase approximation (RPA), density functional theory) 3 Application of mean field theory and the RPA to magnetism 4 BCS theory of superconductivity 		
Intended learning outcomes		
<p>During the two-semester lecture, the students acquire a basic understanding of many topics of Solid-State Physics, which are addressed in classical textbooks, and thereby advance their knowledge of the underlying concepts and the methods of description. The course builds upon the courses "Experimental Condensed Matter Physics" and "Quantum Mechanics".</p>		
Courses (type, number of weekly contact hours, language — if other than German)		
<p>V (4) + R (2)</p> <p>Module taught in: German or English</p>		
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 to 120 minutes) or</p> <p>b) oral examination of one candidate each (approx. 30 minutes) or</p> <p>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</p> <p>d) project report (approx. 8 to 10 pages) or</p> <p>e) presentation/talk (approx. 30 minutes).</p> <p>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.</p> <p>Language of assessment: German and/or English</p> <p>Assessment offered: In the semester in which the course is offered and in the subsequent semester</p>		
Allocation of places		
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Additional information		
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Workload		
240 h		
Teaching cycle		
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Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module appears in

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