



# Subdivided Module Catalogue for the Subject

Keine PO-STG-Zuordnung vorhanden

Responsible: JMU Würzburg

## Learning Outcomes

German contents and learning outcome available but not translated yet.

### **Wissenschaftliche Befähigung**

- Die Absolventinnen und Absolventen können ein breites und vertieftes interdisziplinäres Wissen aus den wichtigsten Disziplinen der Materialwissenschaften abrufen. Die Absolventinnen und Absolventen verstehen die mathematischen, theoretischen und experimentellen Grundlagen der Materialwissenschaften und können diese selbständig anwenden. Sie besitzen Abstraktionsvermögen, analytisches Denken, Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren. Die Grundlagen hierfür werden in Vorlesungen und Übungen der Chemie, Mathematik und Physik vermittelt und mittels Klausuren überprüft.
- Die Absolventinnen und Absolventen können selbständig Experimente durchführen, analysieren und die erhaltenen Ergebnisse darstellen und bewerten. Vermittelt werden diese Fähigkeiten im Rahmen der Projektarbeiten. Die Überprüfung der Zielerreichung findet durch die Erstellung einer Projektarbeit und deren Präsentation mit anschließender Diskussion statt.
- Die Absolventinnen und Absolventen sind in der Lage, sich mit Hilfe von Fachliteratur in neue komplexe interdisziplinäre Aufgabengebiete selbständig einzuarbeiten, naturwissenschaftliche Methoden selbständig auf konkrete experimentelle oder theoretische Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten. Auch diese Fähigkeiten werden im Rahmen Projektarbeiten sowie der Masterarbeit entwickelt und durch die anschließende Bewertung der Arbeit überprüft. Die Absolventinnen und Absolventen können darüber hinaus ihr Wissen und ihre Erkenntnisse einem Fachpublikum gegenüber darstellen und vertreten, was durch das Abschlusskolloquium zur Masterarbeit überprüft wird.

### **Befähigung zur Aufnahme einer Erwerbstätigkeit**

- Die Absolventinnen und Absolventen können mit wissenschaftlichen Methoden auch unbekannte Probleme aus unterschiedlichen fachlichen Perspektiven analysieren und bearbeiten. Der interdisziplinäre Aufbau des Studiengangs, der Elemente aus mathematisch-, ingenieur- und naturwissenschaftlichen Fachbereichen vereint, fördert von Beginn an interdisziplinäres Lernen, Denken und Verstehen. Dies wird durch den Besuch von Lehrveranstaltungen der Physik, Mathematik und Chemie vermittelt und durch die erfolgreiche Absolvierung der Module bestätigt. Diese Problemlösungskompetenz können die Absolventinnen und Absolventen gewinnbringend in ihrer Berufspraxis einsetzen.
- Die Absolventinnen und Absolventen sind darüber hinaus in der Lage, theoretisches Wissen in der Praxis anzuwenden. Der Praxisbezug ist durch die eingangs genannten Kooperationspartner gegeben, sodass die Studierenden in Rahmen von Vorlesungen und Laborpraktika bereits im Bachelorstudium Kontakt zu praxisorientierten außeruniversitären Forschungseinrichtungen haben. Im Masterstudium können die Studierenden ihre Projektarbeiten in diesen Einrichtungen anfertigen, sodass ein direkter Praxisbezug der Forschung gegeben ist. Überprüft wird diese Fähigkeit durch Projektarbeiten und nicht zuletzt die Abschlussarbeit.
- Die Absolventinnen und Absolventen können unterschiedliche Aufgaben parallel und unter Zeit- und Erfolgsdruck auch bei widrigen Rahmenbedingungen erfolgreich bearbeiten. Diese Fähigkeit wird durch die Prüfungsdichte am Ende der Vorlesungszeit erlernt und befähigt die Absolventinnen und Absolventen auch im stressigen Berufsalltag Aufgaben erfolgreich zu bearbeiten.
- Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in einem heterogenen Team zusammenzuarbeiten, unterschiedliche und abweichende Ansichten produktiv zur Zielerreichung zu nutzen und auftretende Konflikte zu lösen. Diese Teamfähigkeit und Konfliktkompetenz erlernen die Studierenden in der Zusammenarbeit in Arbeitskreisen während der Anfertigung der Projekt- und Abschlussarbeit.

### **Persönlichkeitsentwicklung**

- Die Absolventinnen und Absolventen sind bereit und in der Lage, Verantwortung für ihr Handeln und für andere zu übernehmen. Die Absolventinnen und Absolventen verfügen über die kommunikativen Fähigkeiten, komplexe Sachverhalte und Standpunkte im Team zu entwickeln, zielgruppengerecht darzustellen und reflektiert gegenüber abweichenden Positionen zu verteidigen und weiterzuentwickeln. Diese Fähigkeiten, zur Übernahme von Verantwortung, Diskussionsbereitschaft und Teamfähigkeit sowie Eigenverantwortung und Selbständigkeit erlernen und beweisen die Studierenden durch die Anfertigung der Projekt- und Abschlussarbeiten, deren Zielerreichung mit der Bewertung der Arbeit überprüft wird.
- Erst die durch Einübung und Ermutigung erlangte Fähigkeit zur Kritik und Reflexion (inklusive Selbstreflexion und Selbstkritik) ermöglicht eigenständiges Denken und selbstbestimmtes Handeln, das vor sich selbst und anderen begründet ist und rational kommuniziert werden kann. Diese Kritikfähigkeit und Fähigkeit zur Selbstreflexion erlernen die Studierenden mittels Feedbacks durch Lehrende und Studierende zu ihrem Vortrag in Seminaren, die vermehrt im Masterstudium stattfinden.

### **Gesellschaftliches Engagement**

- Die Absolventinnen und Absolventen haben ihr Wissen bezüglich wirtschaftlicher, gesellschaftlicher und naturwissenschaftlicher Fragestellungen erweitert und können begründet Position beziehen. Durch die Behandlung aktueller Forschungsthemen in den Lehrveranstaltungen werden Bezüge zu wirtschaftlichen und gesellschaftlichen Fragestellungen hergestellt. Darüber hinaus können die Absolventinnen und Absolventen gesellschaftliche, naturwissenschaftliche, kulturelle wie auch wirtschaftliche Entwicklungen kritisch reflektieren und deren Auswirkungen auf die Wirtschaft, Gesellschaft und die Umwelt erfassen. Im Rahmen der Projektarbeiten sowie der Masterarbeit befassen sich die Studierenden mit aktuellen gesellschaftlich und wirtschaftlich relevanten materialwissenschaftlichen Fragestellungen, deren Kenntnisse sowie die Fähigkeit begründet Position zu beziehen im Kolloquium überprüft werden.

## 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)):

**??-??-2025 (2025-??)**

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

## The subject is divided into

Abbreviation	Module title	ECTS credits	Method of grading	page
<b>Compulsory Courses (40 ECTS credits)</b>				
11-FU-MTE-161-m01	Mechanical and Thermal Material Properties	5	NUM	76
11-FU-MOE-161-m01	Opto-Electronic Material Properties	5	NUM	75
08-FU-MaWi3-222-m01	Materials Science 3	5	NUM	24
08-OCM-FM-161-m01	Organic Functional Materials	5	NUM	34
08-FU-PR1-161-m01	Research Project 1	10	NUM	28
08-FU-PR2-161-m01	Research Project 2	10	NUM	29
<b>Compulsory Electives (50 ECTS credits)</b>				
<b>Subfield Focus Topic (30 ECTS credits)</b>				
Two focus topics are to be selected, from which modules of 15 ECTS credits each are to be completed.				
<b>Focus Topic I: Functional Materials in Biology and Medicine (15 ECTS credits)</b>				
03-BIOPOL-222-m01	Biopolymers	5	NUM	11
03-BIOFAB-222-m01	Biofabrication	5	NUM	10
03-FU-IMPL-222-m01	Functional Materials in Implantology	5	NUM	13
03-FU-DDEL-222-m01	Nano4Med	5	NUM	12
03-GEWMAT-222-m01	Tissue cells meet materials	5	NUM	15
<b>Focus Topic II: Polymer Functional Materials (15 ECTS credits)</b>				
03-BIOFAB-222-m01	Biofabrication	5	NUM	10
08-FU-PW1-161-m01	Polymer Materials 1: Technology of Polymer Modification	5	NUM	30
03-ADFER-222-m01	Additive Manufacturing	5	NUM	9
08-FU-PW2-161-m01	Polymer Materials 2: Technology of Filler Modification for Polymer Materials	5	NUM	31
03-FU-PM2-222-m01	Polymers II	5	NUM	14
<b>Focus Topic III: Energy Technologies (15 ECTS credits)</b>				
08-FU-EEW-222-m01	Electrochemical Energy Storage and Conversion	5	NUM	22
08-FU-MW-222-m01	Structure-Properties Correlations of Light Materials - Experiments and Numerical Simulations	5	NUM	26
99-HIS-222-m01	Materials for High Voltage insulation and High Voltage Systems	5	NUM	101
11-NTE-152-m01	Nanotechnology in Energy Research	6	NUM	87
11-ENT-152-m01	Principles of Energy Technologies	6	NUM	71
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	79
<b>Focus Topic IV: Semiconductor Nanostructures (15 ECTS credits)</b>				
11-HPH-201-m01	Semiconductor Physics	6	NUM	81
11-SPD-152-m01	Physics of Semiconductor Devices	6	NUM	95
11-OHL-161-m01	Organic Semiconductors	6	NUM	89
11-BVG-202-m01	Coating Technologies based on Vapour Deposition	5	NUM	65
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	79
<b>Focus Topic V: Organic Functional Materials and Applications (15 ECTS credits)</b>				
08-FU-NT-AA-152-m01	Chemical Nanotechnology: Analytics and Applications	5	NUM	27
08-FU-PW1-161-m01	Polymer Materials 1: Technology of Polymer Modification	5	NUM	30
08-PCM3-161-m01	Nanoscale Materials	5	NUM	41

o8-FU-PW2-161-m01	Polymer Materials 2: Technology of Filler Modification for Polymer Materials	5	NUM	31
o8-SCM1-161-m01	Supramolecular Chemistry (Basics)	5	NUM	46
o8-PCM5-161-m01	Physical Chemistry of Supramolecular Assemblies	5	NUM	44
<b>Focus Topic VI: Imaging und Spectroscopy (15 ECTS credits)</b>				
11-ZDR-152-m01	Principles of Two- and Three-Dimensional Röntgen Imaging	6	NUM	97
11-CTA-212-m01	Advanced Computer Tomography	6	NUM	68
11-EIM-211-m01	Electron and Ion Microscopy	6	NUM	70
o8-PCM1a-161-m01	Laser Spectroscopy	5	NUM	37
<b>Subfield General Compulsory Electives (20 ECTS credits)</b>				
The 20 ECTS points can be taken from the following modules.				
Alternatively, within these 20 ECTS credits, modules of the "Subfield Focus Topic (I to V)" can also be completed, whereby the modules already taken in the selected "Subfield Focus Topic" and introduced there cannot be used again in the "Subfield General Compulsory Electives".				
<b>Module Group Material Sciences</b>				
o8-FU-SGC-252-m01	Sol-Gel Chemistry Film / Methods	5	NUM	32
o8-FU-ANA-161-m01	Analytical Methods - Examples from Practical Failure Analysis	5	NUM	20
<b>Module Group Physics</b>				
11-SPD-152-m01	Physics of Semiconductor Devices	6	NUM	95
11-HLF-152-m01	Semiconductor Lasers and Photonics	6	NUM	77
11-QTH-161-m01	Quantum Transport	6	NUM	93
11-ZMB-152-m01	Methods of Non-Destructive Material Testing	4	NUM	99
11-LMT-152-m01	Laboratory and Measurement Technology	6	NUM	85
11-BMT-161-m01	Biophysical Measurement Technology in Medical Science	6	NUM	61
11-HPH-201-m01	Semiconductor Physics	6	NUM	81
11-ZDR-152-m01	Principles of Two- and Three-Dimensional Röntgen Imaging	6	NUM	97
11-PMM-161-m01	Physics of Advanced Materials	6	NUM	91
11-LMB-152-m01	Laboratory and Measurement Technology in Biophysics	6	NUM	83
11-CMS-161-m01	Computational Materials Science (DFT)	8	NUM	66
11-FK2-201-m01	Solid State Physics 2	8	NUM	73
11-BMS-152-m01	Imaging Methods at the Synchrotron	6	NUM	59
11-BSV-161-m01	Image and Signal Processing in Physics	6	NUM	63
<b>Module Group Chemistry</b>				
o8-SCM3-152-m01	Bioorganic Chemistry	5	NUM	47
o8-BC-MOLMC-161-m01	Molecular Biology for Advanced Students	5	NUM	18
o8-OCM-SYNT-161-m01	Modern Synthetic Methods	5	NUM	36
o8-PCM4-242-m01	Ultrafast spectroscopy and quantum-control	5	NUM	43
o8-PCM2-161-m01	Statistical Mechanics and Reaction Dynamics	5	NUM	39
<b>Module Group Theory of Chemistry / Numerics (Mathematics / Computer Science)</b>				
o8-TCM2-161-m01	Basics and Applications of Quantum Chemistry	5	NUM	51
o8-TCM3-161-m01	Numerical Methods and Programming	5	NUM	53
o8-TCM4-161-m01	Quantum Dynamics	5	NUM	55
o8-TCM1-161-m01	Selected Topics in Theoretical Chemistry	5	NUM	49
10-I-PP-152-m01	Practical Course in Programming	10	B/NB	57
10-M-MWR-222-m01	Modelling and Computational Science	10	NUM	58
<b>Module Group Biology</b>				
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o7-4S1MOLB-152-m01	Aspects of Molecular Biotechnology	5	NUM	16
<b>Module Group Biology</b>				
o8-FU-AP-222-m01	Foreign Studies	5	B/NB	21
o8-FU-ALS-222-m01	Foreign Studies with a focus on Materials Science	5	B/NB	19
o8-FU-ST-222-m01	Special Topics of Materials Science	5	B/NB	33
<b>Module Group Focus Topic I: Functional Materials in Biology and Medicine</b>				
o3-BIOPOL-222-m01	Biopolymers	5	NUM	11
o3-BIOFAB-222-m01	Biofabrication	5	NUM	10
o3-FU-IMPL-222-m01	Functional Materials in Implantology	5	NUM	13
o3-FU-DDEL-222-m01	Nano4Med	5	NUM	12
o3-GEWMAT-222-m01	Tissue cells meet materials	5	NUM	15
<b>Module Group Focus Topic II: Polymer Functional Materials</b>				
o3-BIOFAB-222-m01	Biofabrication	5	NUM	10
o8-FU-PW1-161-m01	Polymer Materials 1: Technology of Polymer Modification	5	NUM	30
o3-ADFER-222-m01	Additive Manufacturing	5	NUM	9
o8-FU-PW2-161-m01	Polymer Materials 2: Technology of Filler Modification for Polymer Materials	5	NUM	31
o3-FU-PM2-222-m01	Polymers II	5	NUM	14
<b>Module Group Focus Topic III: Energy Technologies</b>				
o8-FU-EEW-222-m01	Electrochemical Energy Storage and Conversion	5	NUM	22
o8-FU-MW-222-m01	Structure-Properties Correlations of Light Materials - Experiments and Numerical Simulations	5	NUM	26
99-HIS-222-m01	Materials for High Voltage insulation and High Voltage Systems	5	NUM	101
11-NTE-152-m01	Nanotechnology in Energy Research	6	NUM	87
11-ENT-152-m01	Principles of Energy Technologies	6	NUM	71
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	79
<b>Module Group Focus Topic IV: Semiconductor Nanostructures</b>				
11-HPH-201-m01	Semiconductor Physics	6	NUM	81
11-SPD-152-m01	Physics of Semiconductor Devices	6	NUM	95
11-OHL-161-m01	Organic Semiconductors	6	NUM	89
11-BVG-202-m01	Coating Technologies based on Vapour Deposition	5	NUM	65
11-HNS-161-m01	Optical Properties of Semiconductor Nanostructures	6	NUM	79
<b>Module Group Focus Topic V: Organic Functional Materials and Applications</b>				
o8-FU-NT-AA-152-m01	Chemical Nanotechnology: Analytics and Applications	5	NUM	27
o8-FU-PW1-161-m01	Polymer Materials 1: Technology of Polymer Modification	5	NUM	30
o8-PCM3-161-m01	Nanoscale Materials	5	NUM	41
o8-FU-PW2-161-m01	Polymer Materials 2: Technology of Filler Modification for Polymer Materials	5	NUM	31
o8-SCM1-161-m01	Supramolecular Chemistry (Basics)	5	NUM	46
o8-PCM5-161-m01	Physical Chemistry of Supramolecular Assemblies	5	NUM	44
<b>Module Group Focus Topic VI: Imaging und Spectroscopy</b>				
11-ZDR-152-m01	Principles of Two- and Three-Dimensional Röntgen Imaging	6	NUM	97
11-CTA-212-m01	Advanced Computer Tomography	6	NUM	68
11-EIM-211-m01	Electron and Ion Microscopy	6	NUM	70
o8-PCM1a-161-m01	Laser Spectroscopy	5	NUM	37

<b>Thesis (30 ECTS credits)</b>				
o8-FU-MT-161-m01	Master Thesis Functional Materials	25	NUM	25
o8-FU-Koll-161-m01	Master Thesis Defense	5	NUM	23



<b>Module title</b>		<b>Abbreviation</b>
Additive Manufacturing		03-ADFER-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Functional Materials in Medicine and Dentistry		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
<p>The course will cover the basics of additive manufacturing (AM) focusing on the techniques and materials used in AM. All aspects of the 3D printing chain, starting from the CAD design followed by slicing, printer selection and preparation to post processing, will be discussed. Participants will get the possibility to have hand-on experience with different printing methods during practical sessions. Based on current examples, options to transfer the process from prototyping to manufacturing and concepts to implements sustainability into additive manufacturing will be highlighted. The course will also focus on biomedical applications and options how 3D printing can be used in Biofabrication.</p>		
<b>Intended learning outcomes</b>		
The student has advanced knowledge of the synthesis, modification and characterization of polymers.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (1) + P (1) Module taught in: V, Ü: English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 minutes) or  b) oral examination of one candidate each (20 to 30 minutes) or  c) talk (approx. 30 minutes)  Language of assessment: English</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Biofabrication		03-BIOFAB-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Functional Materials in Medicine and Dentistry		Faculty of Medicine
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>Definitions within biomaterials, tissue engineering and biofabrication, overview of medical device regulations and practices, description of extracellular matrix, bioprinting, continuous liquid interface polymerisation, two-photon polymerisation, fused deposition modelling, inorganic powder printing, stereolithography, selective laser sintering, melt electrospinning writing, self-healing hydrogels, polymers in 3D printing, introduction to rheology, scientific method and reproducibility, digital signal generation and quality control.</p>		
<b>Intended learning outcomes</b>		
<p>Students gain a thorough appreciation of the different additive manufacturing (3D printing) technologies available in the context of biofabrication. This includes how the polymers are processed and how each class of 3D printer works, with its strengths and weaknesses. A holistic view of biofabrication is taught, with an understanding of scientific methodology for each stage and the different regulations governing medical devices. Students will acquire the necessary skills to critique and develop opinions on the 3D printing industry and the resulting biomedical applications.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (1) + P (1) Module taught in: V, Ü: English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) talk (approx. 30 minutes) Language of assessment: English</p>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Biopolymers		03-BIOPOL-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Macromolecular Chemistry		Faculty of Medicine
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
<p>Organisms produce biologically active macromolecules (polysaccharides, proteins, nucleic acids, etc.) that perform (survival) important functions in structure, movement, recognition, metabolic and information storage. These naturally occurring polymers can also be isolated, chemically modified and commercialized for further applications. In addition, novel macromolecules can additionally be synthetically derived from bio-based feedstocks, which are increasingly used as sustainable and degradable biopolymers.</p>		
<b>Intended learning outcomes</b>		
<p>The student will acquire fundamental knowledge of naturally occurring macromolecules, their production, function, modification, and application in various biological contexts and everyday areas.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (2) + Ü (1) + P (1)          Module taught in: V, Ü: English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 minutes) or          b) oral examination of one candidate each (20 to 30 minutes) or          c) talk (approx. 30 minutes)          Language of assessment: English</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Master's degree (1 major) Functional Materials (2022)          Master's degree (1 major) Chemistry (2024)</p>		

<b>Module title</b>		<b>Abbreviation</b>
Nano4Med		03-FU-DDEL-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Functional Materials in Medicine and Dentistry		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
Incorporation and Conjugateion of active substances into particle systems, functionalization of the particle systems for transport, targeting and release of active ingredients.		
<b>Intended learning outcomes</b>		
Incorporation and Conjugateion of active substances into particle systems, functionalization of the particle systems for transport, targeting and release of active ingredients.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (1) + Ü (1) + P (1)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 90 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Chemistry (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Functional Materials in Implantology		03-FU-IMPL-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Musculoskeletal Tissue Regeneration		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
Anatomy and physiology of the cardiovascular system, sensory organs, skeletal system, jaw incl. tooth structure as well as pathological processes leading to functional impairment or even loss of function. Materials and use of medical implants in the respective area.		
<b>Intended learning outcomes</b>		
Students receive in-depth basic knowledge in human physiology. They will also gain knowledge of pathological processes that can lead to the use of medical materials and implants. The students have knowledge of the application of implants in various organs and tissues and their compatibility and interaction with the organism.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + P (1)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) report on work placement (approx. 10 pages) or b) presentation (approx. 30 minutes) or c) written examination (approx. 60 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Polymers II		03-FU-PM2-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Functional Materials in Medicine and Dentistry		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Basics as well as advanced knowledge about contemporary issues of polymer synthesis, -modification and characterization.		
<b>Intended learning outcomes</b>		
The student has advanced knowledge of the synthesis, modification and characterization of polymers.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + P (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) talk (approx. 30 minutes) Language of assessment: German and/or English Assessment offered: Once a year, winter semester creditable for bonus		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Chemistry (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Tissue cells meet materials		o3-GEWMAT-222-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Tissue Engineering and Regenerative Medicine		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
The module teaches the following contents: The cell culture techniques required for the construction of artificial tissues (tissue or also bioengineering), the basics of constructing such models using suitable (bio)materials, the use of such models as alternative test systems to animal experimentation. Another topic is the development of cell-based transplants, medical devices and drugs, as well as the regulatory basis for their approval (REACH, GLP, GMP, etc.).		
<b>Intended learning outcomes</b>		
Students will gain content-related and methodological insights into current key topics in tissue engineering as well as the use of these tissues as substitutes for animal models or as transplants in regenerative medicine.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + P (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 90 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
<b>Aspects of Molecular Biotechnology</b>		07-4S1MOLB-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Biotechnology and Biophysics		Faculty of Biology
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Fundamental principles of "white" biotechnology, bioreactors, biocatalysis, immobilisation of cells and enzymes, production of biomolecules, molecular biology, recombinant DNA technology, protein engineering, biosensor design, drug design, drug targeting, molecular diagnostics, recombinant antibodies, hybridoma technology, electromanipulation of cells.		
<b>Intended learning outcomes</b>		
Students will gain an overview of traditional and modern methods in biotechnology and their respective advantages and disadvantages. They will learn to decide what method is most suitable for addressing a particular issue. Students will acquire a knowledge of fundamental methods in biotechnology that will enable them to independently review relevant literature. In addition, they will become acquainted with - or, where necessary, will be able to independently acquaint themselves with - relevant mechanisms.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + S (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 30 to 60 minutes) creditable for bonus		
<b>Allocation of places</b>		
25 places. Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration. A waiting list will be maintained and places re-allocated as they become available. Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking.		



Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.

Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.

Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

**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' degree (1 major) Biology (2015)  
 Bachelor' degree (1 major) Mathematics (2015)  
 Bachelor' degree (1 major) Nanostructure Technology (2015)  
 Bachelor' degree (1 major) Computational Mathematics (2015)  
 Master's degree (1 major) Functional Materials (2016)  
 Bachelor' degree (1 major) Biology (2017)  
 Bachelor' degree (1 major) Nanostructure Technology (2020)  
 Bachelor' degree (1 major) Biology (2021)  
 Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)  
 Bachelor' degree (1 major) Quantum Technology (2021)  
 Bachelor' degree (1 major) Biology (2022)  
 Master's degree (1 major) Functional Materials (2022)  
 exchange program Biosciences (2022)  
 Bachelor' degree (1 major) Mathematics (2023)

<b>Module title</b>		<b>Abbreviation</b>
<b>Molecular Biology for Advanced Students</b>		o8-BC-MOLMC-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Biochemistry		Chair of Biochemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Comprising a lecture and an exercise, this module discusses advanced topics in molecular physiology and functional biochemistry.		
<b>Intended learning outcomes</b>		
Students have developed a sound knowledge of molecular biology.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (1)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Chemistry (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) Chemistry (2018) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Foreign Studies with a focus on Materials Science		o8-FU-ALS-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	(not) successfully completed	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	Please consult with course advisory service in advance.
<b>Contents</b>		
The internship is carried out at universities abroad and can be embedded within offered study programs (eg Erasmus). The content requirements should comply with those of the electives of the Chemistry Master program at the University of Würzburg (what has to be ascertained in advance with the study coordinator).		
<b>Intended learning outcomes</b>		
The students are familiar with working methods at universities abroad. Besides professional competences they have also acquired language and intercultural skills.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
Course(s) as specified by respective institution Module taught in: German and/or English and potentially language of the respective country		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English and potentially language of the respective country		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Analytical Methods - Examples from Practical Failure Analysis		o8-FU-ANA-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Dean of Studies Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module treats special topics in the area damage analysis of materials (Ceramics, semiconductors, metals and polymers). The students become acquainted to different methods for the characterization of the different material classes. They deepen this knowledge in a practical part.		
<b>Intended learning outcomes</b>		
The students gain fundamental knowledge in measuring methods in the physical / chemical laboratory.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + P (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English Assessment offered: Once a year, summer semester P: creditable for bonus		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Foreign Studies		o8-FU-AP-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	(not) successfully completed	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	Please consult with course advisory service in advance.
<b>Contents</b>		
Practical work related to functional materials in a foreign country.		
<b>Intended learning outcomes</b>		
The students apply their knowledge in practical laboratory work and gain basic understanding of the language and the culture of the country visited.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
P (o) Module taught in: German and/or English and potentially language of the respective country		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) report (10 to 20 pages) or b) talk (10 to 20 minutes) Language of assessment: German and/or English and potentially language of the respective country		
<b>Allocation of places</b>		
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<b>Additional information</b>		
Block internship abroad with at least 20 working days		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Electrochemical Energy Storage and Conversion		o8-FU-EEW-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Chemistry and application of battery systems (aqueous and non-aqueous systems like lead, nickel cadmium and nickel metal hydride, sodium sulfur, sodium nickel chloride, lithium ion accumulators), electrochemical double layer capacitors, redox-flow battery, fuel cell systems (AFC, PEMFC, DMFC, PAFC, SOFC), Solar cells (Si, CIS, CIGS, GaAs, organic and dye solar cell), thermoelectric devices.		
<b>Intended learning outcomes</b>		
The students gain comprehensive knowledge in the field of electrochemical energy storage and transformation and are able to apply this to scientific problems.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + S (2) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or oral examination of one candidate each (approx. 30 minutes) and b) talk (approx. 30 minutes); (weighted 65:35) Language of assessment: German and/or English Assessment offered: Once a year, summer semester		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Master Thesis Defense		o8-FU-Koll-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
chairperson of examination committee Funktionswerkstoffe		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	o8-FU-MT
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Prasentation and defense of the results of the Master-Thesis		
<b>Intended learning outcomes</b>		
The students learn how to present and defend a scientific piece of work.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
K (o)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
final colloquium (approx. 60 minutes): talk (approx. 30 minutes) with subsequent discussion (approx. 30 minutes)		
Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016)		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Materials Science 3		o8-FU-MaWi3-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Functional Materials in Medicine and Dentistry		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
The module covers advanced topics in current areas of materials science, such as polymeric materials, nanoparticles, and solids.		
<b>Intended learning outcomes</b>		
Students acquire a comprehensive understanding of modern materials. This includes the production, characterization, properties and application of materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + Ü (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		



<b>Module title</b>		<b>Abbreviation</b>
Master Thesis Functional Materials		o8-FU-MT-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
25	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Students will be expected to research and write on a defined topic in the technology of functional materials, adhering to the principles of good scientific practice.		
<b>Intended learning outcomes</b>		
Students are able to conduct research on a defined topic, adhering to the principles of good scientific practice, and to present the results of their work in written form.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
No courses assigned to module		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
Master's thesis (approx. 70 pages) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
Time to complete: 6 months.		
<b>Workload</b>		
750 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
<b>Structure-Properties Correlations of Light Materials - Experiments and Numerical Simulations</b>		08-FU-MW-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Material properties of metals and ceramics: Struktur-property relationships through experiments and simulation.		
<b>Intended learning outcomes</b>		
The students gain fundamental knowledge about the properties of modern materials: aviation aluminum alloys and high performance ceramics. Analytical methods and predictions through numerical simulations will be presented. The relationship of mikro- and nanoscopic structure of materials and the resulting properties are emphasized.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + S (2) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or oral examination of one candidate each (approx. 30 minutes) and b) talk (approx. 30 minutes); (weighted 60:40) Language of assessment: German and/or English Assessment offered: Once a year, summer semester		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Chemical Nanotechnology: Analytics and Applications		o8-FU-NT-AA-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Introduction to the theory and application of characterisation methods in nanotechnology. Thermoanalysis, rheological methods, dynamic light scattering. Application of nanomaterials in industry and technology.		
<b>Intended learning outcomes</b>		
Students have developed an advanced knowledge of the characterisation and application of nanomaterials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (4)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Bachelor' degree (1 major) Nanostructure Technology (2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Nanostructure Technology (2020) Bachelor' degree (1 major) Quantum Technology (2021) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Research Project 1		o8-FU-PR1-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
10	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module gives students the opportunity to work independently on experiments on a topic in functional materials.		
<b>Intended learning outcomes</b>		
Students are able to independently work on a defined topic in functional materials and to present their findings in written form.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
R (10)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
report (approx. 25 pages) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
300 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Research Project 2		o8-FU-PR2-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
10	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module gives students the opportunity to work independently on experiments on a topic in functional materials.		
<b>Intended learning outcomes</b>		
Students are able to independently work on a defined topic in functional materials and to present their findings in written form.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
R (10)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
report (approx. 25 pages) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
--		
<b>Workload</b>		
300 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Polymer Materials 1: Technology of Polymer Modification		o8-FU-PW1-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Polymer synthesis methods; the structure of polymers and polymer compounds; properties of polymers; technologies for the manufacturing of polymer compounds and components, procedures for the characterisation of polymer compounds and components.		
<b>Intended learning outcomes</b>		
Students have developed a knowledge of the special properties of polymers and polymer compounds (e.g. time and temperature-dependent viscoelastic behaviour). They have become familiar with the characteristics of important production technologies (polymer synthesis methods, compounding technologies, processing methods such as injection moulding) and understand the different ways of influencing the properties of materials and manufactured products. They have become familiar with ways to calculate complex flow conditions in polymer processing machines and tools.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + P (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) Language of assessment: German and/or English Assessment offered: Once a year, winter semester P: creditable for bonus		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Polymer Materials 2: Technology of Filler Modification for Polymer Materials		o8-FU-PW2-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
degree programme coordinator Funktionswerkstoffe (Functional Materials)		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Principles of and technologies for the functionalisation of filler materials in order to modify polymers, interactions between filler materials and polymers, determination of the special properties of functionalised polymers (e.g. electrical behaviour, bactericidal behaviour) and influence of functionalisation on other properties (e.g. rheology, mechanical behaviour, colour, surface).		
<b>Intended learning outcomes</b>		
Students have become familiar with technologies for the functionalisation of filler materials. They have developed an awareness of the possibilities and problems associated with the modification of polymers as well as the interactions between filler materials and polymers. They know how to determine the special properties of functionalised polymers (e.g. electrical behaviour, bactericidal behaviour) and understand how other properties are influenced by functionalisation (e.g. rheology, mechanical behaviour, colour, surface).		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + P (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) Language of assessment: German and/or English Assessment offered: Once a year, summer semester P: creditable for bonus		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Sol-Gel Chemistry Film / Methods		o8-FU-SGC-252-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
2 semester	undergraduate	--
<b>Contents</b>		
This module provides an introduction to the synthesis methods of sol-gel chemistry and discusses the methods of analysis used to characterise the generated materials.		
<b>Intended learning outcomes</b>		
Students have developed an advanced knowledge of sol-gel chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + V (2) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
keinem Studiengang zugeordnet		



<b>Module title</b>		<b>Abbreviation</b>
Special Topics of Materials Science		o8-FU-ST-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
holder of the Chair of Chemical Technology of Material Synthesis		Chair of Chemical Technology of Material Synthesis
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	(not) successfully completed	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	--	--
<b>Contents</b>		
The module covers current and/or special topics in Materials Chemistry.		
<b>Intended learning outcomes</b>		
The student has advanced knowledge of selected topics in Materials Chemistry. He/she is able to classify the acquired knowledge in the subject-specific contexts, knows the synthetic methods, the properties, the characterization methods und the application areas.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Organic Functional Materials		o8-OCM-FM-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar "Organische Funktionsmaterialien"		Institute of Organic Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>The module deals with specific topics in organic functional materials. The focus is on fundamental (photo)physical effects in organic molecular and polymeric semiconductors as well as their application in (opto)electronic components such as field effect transistors, organic light-emitting diodes, or organic solar cells as well as in non-linear optics.</p>		
<b>Intended learning outcomes</b>		
<p>The students are able to explain fundamental (photo)physical processes in organic semiconductors. He/She can explain the synthesis of these semiconductor materials as well as their application in (opto)electronic components such as field effect transistors, organic light-emitting diodes or in organic photovoltaics as well as in nonlinear optics.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (3)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 90 to 180 minutes) or          b) oral examination of one candidate each (20 to 30 minutes) or          c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or          d) log (approx. 20 pages) or          e) presentation (approx. 30 minutes)          Language of assessment: German and/or English</p>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
<p>Master's degree (1 major) Chemistry (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) Chemistry (2018)          Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)          Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)          Master's degree (1 major) Functional Materials (2022)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 34 / 101

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

<b>Module title</b>		<b>Abbreviation</b>
Modern Synthetic Methods		o8-OCM-SYNT-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar		Institute of Organic Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module discusses modern stereoselective synthesis methods. It focuses on selected total syntheses, organometallic chemistry and catalysis.		
<b>Intended learning outcomes</b>		
Students are able to stereoselectively plan complex chemical syntheses and to stereochemically analyse them. They can explain total syntheses. They can describe aspects of organometallic chemistry and catalysis in synthesis chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (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) Chemistry (2018) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Chemistry (2024)		

<b>Module title</b>		<b>Abbreviation</b>
<b>Laser Spectroscopy</b>		o8-PCM1a-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of seminar "Laserspektroskopie" (Laser Spectroscopy)		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module introduces students to the fundamental principles of laser spectroscopy. It discusses absorption and emission spectroscopy.		
<b>Intended learning outcomes</b>		
Students are able to explain the components and operating principles of lasers as well as the optical principles of laser technology. They are able to describe the principles of absorption and emission spectroscopy.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022)		
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Master's degree (1 major) Mathematics (2022)  
Master's degree (1 major) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Statistical Mechanics and Reaction Dynamics		o8-PCM2-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of seminar "Chemische Dynamik" (Chemical Dynamics)		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module discusses selected topics in statistical mechanics and reaction dynamics. Topics to be covered include the fundamental principles of statistical thermodynamics, the transition state theory, uni- and bimolecular reactions as well as charge and energy transfer.		
<b>Intended learning outcomes</b>		
Students have become familiar with selected topics in statistical mechanics and reaction dynamics. They have learned and are able to apply the fundamental principles of statistical thermodynamics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) 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 Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 39 / 101

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



<b>Module title</b>		<b>Abbreviation</b>
Nanoscale Materials		o8-PCM3-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar "Nanoskalige Materialien"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module discusses advanced topics in nanoscale materials. It focuses on the structure, properties, fabrication, modern characterisation methods and application areas of nanoscale materials.		
<b>Intended learning outcomes</b>		
Students are able to characterise nanoscale materials. They are able to name analytical methods and application areas of nanoscale materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes) Language of assessment: German and/or English creditable for bonus		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) 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' degree (1 major) Quantum Technology (2021)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 41 / 101

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

<b>Module title</b>		<b>Abbreviation</b>
Ultrafast spectroscopy and quantum-control		o8-PCM4-242-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar "Nanoskalige Materialien"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	Prior completion of modules o8-PCM1a and o8-PCM1b recommended.
<b>Contents</b>		
This module discusses advanced topics in ultrafast spectroscopy and quantum control. It focuses on ultrashort laser pulses, time-resolved laser spectroscopy and coherent control.		
<b>Intended learning outcomes</b>		
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.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) oral examination of one candidate each (approx. 20 minutes) or b) talk (approx. 30 minutes) or c) portfolio (approx. 50 hours total) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Physical Chemistry of Supramolecular Assemblies		o8-PCM5-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar "Physikalische Chemie Supramolekularer Strukturen"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module examines the basic interactions between molecules. It discusses the formation and physical-chemical properties of aggregates as well as key applications of supramolecular chemistry.		
<b>Intended learning outcomes</b>		
Students are able to explain the basic interactions between molecules demonstrating a high degree of expertise in the field. They can describe the formation and physical-chemical properties of aggregates. They can name modern applications of supramolecular chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) 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)		
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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) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Supramolecular Chemistry (Basics)		o8-SCM1-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of the seminar "Supramolecular Chemistry (Basics)"		Institute of Organic Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>This module introduces students to the fundamental principles of supramolecular chemistry. It focuses on interactions between molecules, molecular recognition by receptors, complexes, supramolecular polymers, coordination polymers and networks, liquid crystals, self-assembly in aqueous media, synthetic ion channels and modern applications of supramolecular chemistry.</p>		
<b>Intended learning outcomes</b>		
<p>Students are able to explain interactions between molecules demonstrating a high degree of expertise in the field as well as to describe the formation, structure and polymers of coordination compounds. They are able to describe the self-assembly of polymers in aqueous media as well as to identify the characteristics of synthetic ion channels. They can name modern applications of supramolecular chemistry.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (3) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Chemistry (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Bioorganic Chemistry		o8-SCM3-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of lecture "Bioorganische Chemie" (Bioorganic Chemistry)		Institute of Organic Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>Bioorganic chemistry unites the central questions of organic chemistry, biochemistry, medicinal chemistry and spectroscopy with a focus on biomolecules. At the core of bioorganic chemistry is the synthesis and purposeful manipulation of biomolecules, such as nucleic acids, peptides, proteins, carbohydrates and lipids. This includes the framework of structure-function relationships and the fundamental understanding of biological mechanisms, to enable applications towards biomaterials, biosensing, bioimaging, clinical diagnostics and therapeutics.</p> <p>Key concepts covered in the course are nucleic acid chemistry, peptide chemistry, carbohydrate chemistry, bioorthogonal reactions, molecular diversity, solid-phase synthesis, molecular recognition and interactions (ligand-receptor interactions, signal transduction)</p>		
<b>Intended learning outcomes</b>		
<p>The students will have a molecular understanding of the structure and reactivity of biomolecules. The students obtain knowledge of modern synthetic methods in bioorganic chemistry and can explain principles of molecular interactions and recognition mechanisms. They can describe modern aspects of nucleic acids, proteins, carbohydrates and lipids.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (3)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<p>a) written examination (approx. 45 to 90 minutes) or          b) oral examination of one candidate each (20 to 30 minutes) or          c) oral examination in groups of up to 3 candidates (15 to 30 minutes per candidate)          Language of assessment: German and/or English</p>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
<p>Master's degree (1 major) Biochemistry (2015)          Master's degree (1 major) Chemistry (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)</p>		
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Master's degree (1 major) Biochemistry (2017)  
Master's degree (1 major) Chemistry (2018)  
Master's degree (1 major) Biochemistry (2019)  
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
Master's degree (1 major) Functional Materials (2022)  
Master's degree (1 major) Chemistry (2024)



<b>Module title</b>		<b>Abbreviation</b>
Selected Topics in Theoretical Chemistry		o8-TCM1-161-mo1
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of lecture "Theoretische Chemie"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module introduces students to the fundamental principles of theoretical chemistry.		
<b>Intended learning outcomes</b>		
Students are able to describe the mathematical and physical principles underlying the quantum chemical and quantum dynamical approaches of theoretical chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022)		
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Master's degree (1 major) Mathematics (2022)  
Master's degree (1 major) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Basics and Applications of Quantum Chemistry		o8-TCM2-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of lecture "Computational Chemistry"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module introduces students to the fundamental principles of computational chemistry.		
<b>Intended learning outcomes</b>		
Students are able to explain the theoretical principles of computational chemistry and to apply methods in computational chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022)		
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Master's degree (1 major) Mathematics (2022)  
Master's degree (1 major) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Numerical Methods and Programming		o8-TCM3-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of lecture "Programmieren in Theoretischer Chemie"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
This module provides an introduction to the fundamentals of programming in theoretical chemistry and discusses its application areas.		
<b>Intended learning outcomes</b>		
Students are able to explain and use one of the programming languages typically used in theoretical chemistry as well as to name its application areas.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) 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)		
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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) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Quantum Dynamics		o8-TCM4-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
lecturer of lecture "Quantendynamik"		Institute of Physical and Theoretical Chemistry
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Time-dependent Schrödinger equation, propagators, time-dependent perturbation theory, adiabatic theorem, diabatic and adiabatic states, non-adiabatic dynamics, mixed quantum-classical dynamics.		
<b>Intended learning outcomes</b>		
The students possess knowledge about the time-dependent description of the nuclear and electronic dynamics in molecules. Their insight into the methods and the numerical realizations allow them to carry out applications in the field of theoretical chemistry.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
S (2) + Ü (2)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) Language of assessment: German and/or English		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (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) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) 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)		
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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) Chemistry (2024)  
Master's degree (1 major) Computational Mathematics (2024)  
Master's degree (1 major) Mathematics (2024)



<b>Module title</b>		<b>Abbreviation</b>
Practical Course in Programming		10-I-PP-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Dean of Studies Informatik (Computer Science)		Institute of Computer Science
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
10	(not) successfully completed	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
	undergraduate	--
<b>Contents</b>		
The programming language Java. Independent creation of small to middle-sized, high-quality Java programs.		
<b>Intended learning outcomes</b>		
The students are able to independently develop small to middle-sized, high-quality Java programs.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
P (6)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
written examination (approx. 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).		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
300 h		
<b>Teaching cycle</b>		
Teaching cycle: every semester		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 49 I Nr. 1 c) § 69 I Nr. 1 d)		
<b>Module appears in</b>		
Bachelor' degree (1 major) Computer Science (2015) Bachelor' degree (1 major) Mathematics (2015) Bachelor' degree (1 major) Human-Computer Systems (2015) Bachelor' degree (1 major) Computational Mathematics (2015) Bachelor' degree (1 major) Aerospace Computer Science (2015) First state examination for the teaching degree Realschule Computer Science (2015) First state examination for the teaching degree Gymnasium Computer Science (2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Computer Science (2017) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Modelling and Computational Science		10-M-MWR-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
10	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Aspects of mathematical modelling of technical or scientific processes. Basic principles of modelling, aspects of scaling the modelling, asymptotic series, classical methods for solving ordinary and partial differential equations, fundamental methods for numerical solution of partial differential equations and the resulting systems of linear equations.		
<b>Intended learning outcomes</b>		
The student masters the fundamental mathematical methods and techniques to simulate processes from natural and engineering sciences on a computer.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (4) + Ü (2) Module taught in: German and/or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 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 Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
300 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022) Bachelor' degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) Bachelor' degree (1 major) Mathematical Physics (2024)		

<b>Module title</b>		<b>Abbreviation</b>
Imaging Methods at the Synchrotron		11-BMS-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
<p>Periodic and aperiodic signals. Fundamentals of discrete and exact Fourier transform. Basics of digital signal and image processing. Discretisation of signals / sampling theorem (Shannon). Homogeneous and linear filter, the convolution product. Tapering functions and interpolation of images. The Parsival theorem, correlation and energetic aspects. Statistical signals, image noise, moments, stationary signals. Tomography: Hankel and Radon transform.</p>		
<b>Intended learning outcomes</b>		
<p>The students know the principles of digital image and signal processing. They know the ways of functioning and applications of different image processing methods and are able to apply them in practice.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
--		
<b>Module appears in</b>		
<p>Bachelor' degree (1 major) Physics (2015) Bachelor' degree (1 major) Nanostructure Technology (2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Physics (2020)</p>		
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Bachelor' degree (1 major) Nanostructure Technology (2020)  
Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
Biophysical Measurement Technology in Medical Science		11-BMT-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>The lecture covers the physical principles of imaging techniques and their application in Biomedicine. The main topics are conventional X-ray technique, computer tomography, imaging techniques of nuclear medicine, ultrasound and MR-tomography. The lecture additionally addresses the systems theory of imaging systems and digital image processing.</p>		
<b>Intended learning outcomes</b>		
<p>The students know the physical principles of imaging techniques and their application in Biomedicine. They understand the principles of image generation and are able to explain different techniques and interpret simple images.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Master's degree (1 major) Physics (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)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 61 / 101

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

<b>Module title</b>		<b>Abbreviation</b>
Image and Signal Processing in Physics		11-BSV-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>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.</p>		
<b>Intended learning outcomes</b>		
<p>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.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (2) + Ü (2) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 63 / 101

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



<b>Module title</b>		<b>Abbreviation</b>
Coating Technologies based on Vapour Deposition		11-BVG-202-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Physical and technical basics of PVD and CVD systems and processes. Layer deposition and layer characterization. Application of coating materials on an industrial scale.		
<b>Intended learning outcomes</b>		
The student has in-depth knowledge in the field of gas-phase deposition processes and gains insights into their industrial significance and diversity.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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: Once a year, summer semester  creditable for bonus</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2020) Bachelor' degree (1 major) Nanostructure Technology (2020) Bachelor' degree (1 major) Quantum Technology (2021) Master's degree (1 major) Functional Materials (2022) exchange program Physics (2023)		

<b>Module title</b>		<b>Abbreviation</b>
Computational Materials Science (DFT)		11-CMS-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
8	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<ol style="list-style-type: none"> <li>1. Density functional theory (DFT)</li> <li>2. Wannier functions and localized basis functions</li> <li>3. Numerical evaluation of topological invariants</li> <li>4. Hartree-Fock and static mean-field theory</li> <li>5. Many-body methods for solid state physics</li> <li>6. Anderson impurity model (AIM) and Kondo physics</li> <li>7. Dynamical mean-field theory (DMFT)</li> <li>8. DFT + DMFT methods for realistic modeling of solids</li> <li>9. Strongly correlated electrons</li> </ol>		
<b>Intended learning outcomes</b>		
<p>Aside from the theoretical discussion of these topics, the students carry out hands-on exercises from the CIP pool. The participants are introduced to the use of DFT software packages such as VASP or Wien2k and to the construction of maximally localised Wannier functions through the projection of DFT results on atom orbitals with the software wanniergo. Furthermore, the students learn how to construct many-particle solutions of AIM and observe border cases such as the Kondo regime. Impurity solvers such as exact diagonalisation or continuous-time quantum Monte Carlo are utilised to solve the self consistency equations of dynamic molecular field theory (DMFT). These steps are necessary to reach the peak of the lecture: a DFT-DMFT calculation of a strongly correlated transition metal oxide such as SrVO<sub>3</sub>.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (4) + R (2) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<ol style="list-style-type: none"> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> </ol> <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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
240 h		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 66 / 101

<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
--
<b>Module appears in</b>
<p>Master's degree (1 major) Mathematics (2016)  Master's degree (1 major) Physics (2016)  Master's degree (1 major) Mathematical Physics (2016)  Master's degree (1 major) Computational Mathematics (2016)  Master's degree (1 major) Functional Materials (2016)  Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)  Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)  Master's degree (1 major) Computational Mathematics (2019)  Master's degree (1 major) Mathematics (2019)  Master's degree (1 major) Physics (2020)  Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  Master's degree (1 major) Mathematical Physics (2020)  Master's degree (1 major) Computational Mathematics (2022)  Master's degree (1 major) Functional Materials (2022)  Master's degree (1 major) Mathematics (2022)  Master's degree (1 major) Mathematical Physics (2022)  Master's degree (1 major) Computational Mathematics (2024)  Master's degree (1 major) Mathematics (2024)</p>

<b>Module title</b>		<b>Abbreviation</b>
Advanced Computer Tomography		11-CTA-212-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>This advanced course focuses on the details of modern computed tomography (CT), which is employed both in medical and industrial imaging applications. In addition to the technicalities of CT systems and their application to various tasks in engineering and medical science, this lecture emphasizes on the mathematics of “inverting the Radon transform”. Starting with the simple Filtered Back Projection method which is applied to a variety of standard recording geometries (parallel, fan, cone, helix) the advanced course lays out the strategies for algebraic reconstruction techniques (ART) along with many types of regularization schemes which may accompany these methods. Students will have the opportunity to see how Radon data is recorded and how different error sources as well as the corresponding correction schemes influence the outcome of the reconstructed volume images. Finally, the most common tools for volume image analysis are presented, such as distance transforms, watersheds, labelling and fiber orientation analysis.</p>		
<b>Intended learning outcomes</b>		
<p>The student know the concept of Computed tomography (CT) and its applications. From the formulation of the basic inverse problem posed by this technique the students are able to derive strategies for different numerical solutions, based on Fourier analysis and/or based on probability theory. Most importantly the students have a firm impression (first-hand experience) of the various sources of measurement errors in CT which can impede any wellprepared reconstruction.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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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 (2020)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
Electron and Ion Microscopy		11-EIM-211-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
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.		
<b>Intended learning outcomes</b>		
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.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
--		
<b>Additional information</b>		
--		
<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
Teaching cycle: annually, after announcement		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Nanostructure Technology (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)		
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<b>Module title</b>		<b>Abbreviation</b>
Principles of Energy Technologies		11-ENT-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Physical principles of energy conservation and energy conversion, energy transport and energy storage as well as renewable resources of energy. We also discuss aspects of optimising materials (e.g. nanostructured insulating materials, selective layers, highly activated carbons). The course is especially suitable for teaching degree students. Energy conservation via thermal insulation. Thermodynamic energy efficiency. Fossil fired energy converters. Nuclear power plants. Hydroelectricity. Wind turbines. Photovoltaics. Solar thermal: Heat. Solar thermal: Electricity. Biomass. Geothermal energy. Energy storage. Energy transport		
<b>Intended learning outcomes</b>		
The students know the principles of different methods of energy technology, especially energy conversion, transport and storage. They understand the structures of corresponding installations and are able to compare them.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 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: Once a year, winter semester		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
§ 22 II Nr. 1 h) § 22 II Nr. 2 f) § 22 II Nr. 3 f)		
<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2015)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 71 / 101

Bachelor' degree (1 major) Nanostructure Technology (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)  
 Master's degree (1 major) Functional Materials (2016)  
 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)  
 Bachelor' degree (1 major) Physics (2020)  
 Bachelor' degree (1 major) Nanostructure Technology (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)  
 Bachelor' degree (1 major) Quantum Technology (2021)  
 Master's degree (1 major) Functional Materials (2022)  
 exchange program Physics (2023)



<b>Module title</b>		<b>Abbreviation</b>
Solid State Physics 2		11-FK2-201-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
8	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	Approval from examination committee required.
<b>Contents</b>		
<p>1. Electrons in a periodic potential - the band structure</p> <p>a. Electrical and thermal transport</p> <p>b. Bloch theorem</p> <p>c. Electrons</p> <p>2. Semi-classical models of dynamic processes</p> <p>a. Electrical transport in partially and completely filled bands</p> <p>b. Fermi surfaces; measurement techniques</p> <p>c. Electrical transport in external magnetic fields</p> <p>d. Boltzmann-equations of transport</p> <p>3. The dielectric function and ferroelectrics</p> <p>a. Macroscopic electrodynamics and microscopic theory</p> <p>b. Polarizability of solids, of lattices, of valence electrons and quasi-free electrons; optical phonons, polaritons, plasmons, inter-band transitions, Wannier-Mott excitons</p> <p>c. Ferromagnetism</p> <p>4. Semiconductors</p> <p>a. Characteristics</p> <p>b. Intrinsic semiconductors</p> <p>c. Doped semiconductors</p> <p>d. Physics and applications of p-n junctions</p> <p>e. Heterostructures</p> <p>5. Magnetism</p> <p>a. Atomic dia- and paramagnetism</p> <p>b. Dia- and paramagnetism in metals</p> <p>c. Ferromagnetism</p> <p>6. Superconductivity</p> <p>a. Phenomena</p> <p>b. Models of superconductivity</p> <p>c. Tunnel experiments und applications</p>		
<b>Intended learning outcomes</b>		
Knowledge of effects, concepts and models in advanced solid state physics. Familiarity with the theoretical principles and with applications of experimental methods.		
<b>Courses</b> (type, number of weekly contact hours, language – if other than German)		
V (4) + R (2) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language – if other than German, examination offered – if not every semester, information on whether module can be chosen to earn a bonus)		
<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</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**

--

**Additional information**

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**Workload**

240 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) Nanostructure Technology (2020)

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

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

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

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

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

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

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

exchange program Physics (2023)

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

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

<b>Module title</b>		<b>Abbreviation</b>
Opto-Electronic Material Properties		11-FU-MOE-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Physical principles of optoelectronic material properties and applications..		
<b>Intended learning outcomes</b>		
The students know the principles of optoelectronic material characteristics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + Ü (1) Module taught in: Ü: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
<b>Mechanical and Thermal Material Properties</b>		11-FU-MTE-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Physical laws of solids: Bonding and structure, lattice dynamics, thermal and mechanical properties.		
<b>Intended learning outcomes</b>		
The students have knowledge of mechanical/thermal material characteristics.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + Ü (1) Module taught in: Ü: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2016) Master's degree (1 major) Functional Materials (2022)		

<b>Module title</b>		<b>Abbreviation</b>
Semiconductor Lasers and Photonics		11-HLF-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>This lecture discusses the principles of laser physics, based on the example of semiconductor lasers, and current developments regarding components. The principles of lasers are described on the basis of a general laser model, which will then be extended to special aspects of semiconductor lasers. Basic concepts such as threshold condition, characteristic curve and laser efficiency are derived from coupled rate equations for charge carriers and photons. Other topics of the lecture are optical processes in semiconductors, layer and ridge waveguides, laser resonators, mode selection, dynamic properties as well as technology for the generation of semiconductor lasers. The lecture closes with current topics of laser research such as quantum dot lasers, quantum cascade lasers, terahertz lasers or high-performance lasers.</p>		
<b>Intended learning outcomes</b>		
<p>The students have advanced knowledge of the principles of semiconductor-laser physics. They can apply their knowledge to modern questions and know the applications in the current development of components.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2015)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 77 / 101

Bachelor' degree (1 major) Nanostructure Technology (2015)  
Master's degree (1 major) Functional Materials (2016)  
Bachelor' degree (1 major) Physics (2020)  
Bachelor' degree (1 major) Nanostructure Technology (2020)  
Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
Optical Properties of Semiconductor Nanostructures		11-HNS-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>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.</p>		
<b>Intended learning outcomes</b>		
<p>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.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Mathematics (2016)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 79 / 101

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



<b>Module title</b>		<b>Abbreviation</b>
Semiconductor Physics		11-HPH-201-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>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.</p>		
<b>Intended learning outcomes</b>		
<p>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.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>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)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 81 / 101

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)

<b>Module title</b>		<b>Abbreviation</b>
Laboratory and Measurement Technology in Biophysics		11-LMB-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>The lecture covers relevant principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. The main topics are optical measuring techniques and sensors, methods of single-particle detection, special microscoping techniques and methods of structure elucidation of biomolecules.</p>		
<b>Intended learning outcomes</b>		
<p>The students know the principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. They have knowledge of optical measuring techniques and their applications and are able to apply techniques of structure elucidation to simple biomolecules.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Bachelor' degree (1 major) Physics (2015)  Bachelor' degree (1 major) Nanostructure Technology (2015)  Master's degree (1 major) Functional Materials (2016)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 83 / 101

Bachelor' degree (1 major) Physics (2020)  
Bachelor' degree (1 major) Nanostructure Technology (2020)  
Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
Laboratory and Measurement Technology		11-LMT-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Introduction to electronic and optical measuring methods of physical metrology, vacuum technology and cryogenics, cryogenics, light sources, spectroscopic methods and measured value acquisition.		
<b>Intended learning outcomes</b>		
The students have competencies in the field of electronic and optical measuring methods of physical metrology, vacuum technology and cryogenics, cryogenics, light sources, spectroscopic methods and measured value acquisition.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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: Once a year, winter semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
--		
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2015) Bachelor' degree (1 major) Nanostructure Technology (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Physics (2020) Bachelor' degree (1 major) Nanostructure Technology (2020)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 85 / 101

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020)  
Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
Nanotechnology in Energy Research		11-NTE-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>Nanotechnology is of great significance for energy research. Energy efficiency can be heightened in numerous processes or applications by using special functional materials. This module covers special materials, surfaces and structures that have optimised properties due to effects of nanotechnology. It explains the underlying physical contexts. It uses specific materials and components as examples, such as thermal insulation materials, heat accumulators, functional nanoscale layer and particle systems with spectral selective properties, nanoporous vacuum insulations and electrode materials.</p>		
<b>Intended learning outcomes</b>		
<p>The students have specific and advanced knowledge of the application of nanotechnology in the field of energy research. They know methods of nanotechnology to influence the properties of materials and their applications. They are able to apply their knowledge to specific questions.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Bachelor' degree (1 major) Nanostructure Technology (2015) Bachelor' degree (1 major) Nanostructure Technology (2020)</p>		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 87 / 101

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



<b>Module title</b>		<b>Abbreviation</b>
Organic Semiconductors		11-OHL-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Fundamentals of organic semiconductors, molecular and polymer electronics and sensor technology, applications.		
<b>Intended learning outcomes</b>		
The students have advanced knowledge of organic semiconductors.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)		
Master's with 1 major Functional Materials (2025)	JMU Würzburg • generated 05-Nov-2024 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2025	page 89 / 101

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)

<b>Module title</b>		<b>Abbreviation</b>
Physics of Advanced Materials		11-PMM-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.		
<b>Intended learning outcomes</b>		
The students know the properties and characterization methods of some modern materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
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 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)		
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Master's degree (1 major) Computational Mathematics (2019)  
 Master's degree (1 major) Mathematics (2019)  
 Master's degree (1 major) Nanostructure Technology (2020)  
 Master's degree (1 major) Physics (2020)  
 Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
 Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
 Master's degree (1 major) Quantum Technology (2021)  
 Master's degree (1 major) Computational Mathematics (2022)  
 Master's degree (1 major) Functional Materials (2022)  
 Master's degree (1 major) Mathematics (2022)  
 exchange program Physics (2023)  
 Master's degree (1 major) Computational Mathematics (2024)  
 Master's degree (1 major) Mathematics (2024)

<b>Module title</b>		<b>Abbreviation</b>
Quantum Transport		11-QTH-161-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>The lecture addresses the fundamental transport phenomena of electrons in nanostructures. This includes the topics of: ballistic and diffuse transport, electron interference effects, quantisation of conductivity, interaction phenomena between electrons, Coulomb blockade, thermoelectric properties, description of spin-dependent transport phenomena, topological insulators, solid-state quantum computers.</p>		
<b>Intended learning outcomes</b>		
<p>The students have mastered the basics of electronics of nanostructures in theory and practice. They know functions and applications of respective components.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>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 degree (1 major) Functional Materials (2016)</p>		
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Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)  
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)  
Master's degree (1 major) Computational Mathematics (2019)  
Master's degree (1 major) Mathematics (2019)  
Master's degree (1 major) Functional Materials (2022)

<b>Module title</b>		<b>Abbreviation</b>
Physics of Semiconductor Devices		11-SPD-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
<p>Based on the fundamentals of Semiconductor Physics, the lecture provides an insight into semiconductor key technologies and discusses the main components in the fields of electronics and photonics on the basis of examples. The basic part introduces the crystal structures and band and phonon dispersions of technologically relevant semiconductors. The following part discusses the principles of charge transport involving non-equilibrium effects based on the charge carrier density of the thermal equilibrium. The part on technology gives an insight into the methods of production of semiconductor materials and presents the most important methods of planar technology. It discusses the way of functioning of the following components, sorted according to volume components, interface components and application fields: Rectifier diodes, Zener diodes, varistor, varactor, tunnel diodes, IMPATT, Baritt- and Gunn diodes, photodiode, solar cell, LED, semiconductor injection laser, transistor, JFET, Thyristor, Diac, Triac, Schottky diode, MOSFET, MESFET, HFET. It highlights the importance of low-dimensional charge carrier systems for technology and basic research and shows recent developments in the components sector.</p>		
<b>Intended learning outcomes</b>		
<p>The students know the characteristics of semiconductors, they have gained an overview of the electronic and phonon band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport as well as the Poisson, Boltzmann and continuity equation for the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the theories of planar technology and recent developments in this field, they have a basic understanding of component production. They understand the structure and way of functioning of the main components of electronics (diode, transistor, field-effect transistor, thyristor, diac, triac), of microwave applications (tunnel, Impatt, Baritt or Gunn diode) and of optoelectronics (photo diode, solar cell, light-emitting diode, semiconductor injection laser), they know the realisation possibilities of low-dimensional charge carrier systems on the basis of semiconductors and their technological relevance, they are familiar with current developments in the field of components.</p>		
<b>Courses</b> (type, number of weekly contact hours, language – if other than German)		
V (3) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language – if other than German, examination offered – if not every semester, information on whether module can be chosen to earn a bonus)		
<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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>
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<b>Workload</b>
180 h
<b>Teaching cycle</b>
--
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
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<b>Module appears in</b>
<p>Bachelor' degree (1 major) Physics (2015)          Bachelor' degree (1 major) Nanostructure Technology (2015)          Master's degree (1 major) Functional Materials (2016)          Bachelor' degree (1 major) Physics (2020)          Bachelor' degree (1 major) Nanostructure Technology (2020)          Bachelor' degree (1 major) Quantum Technology (2021)          Master's degree (1 major) Functional Materials (2022)          exchange program Physics (2023)</p>



<b>Module title</b>		<b>Abbreviation</b>
Principles of Two- and Three-Dimensional Röntgen Imaging		11-ZDR-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
6	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
<p>Physics of X-ray generation (X-ray tubes, synchrotron). Physics of the interaction between X-rays and matter (photon absorption, scattering), physics of X-ray detection. Mathematics of reconstruction algorithms (filtered rear projection, Fourier reconstruction, iterative methods). Image processing (image data pre-processing, feature extraction, visualisation,...). Applications of X-ray imaging in the industrial sector (component testing, material characterisation, metrology, biology, ...). Radiation protection and biological radiation effect (dose, ...).</p>		
<b>Intended learning outcomes</b>		
<p>The students know the principles of generating X-rays and of their interactions with matter. They know imaging techniques using X-rays and methods of image processing as well as application areas of these methods.</p>		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
<p>V (3) + R (1) Module taught in: German or English</p>		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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). 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: Once a year, summer semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
180 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
<p>Bachelor' degree (1 major) Physics (2015) Bachelor' degree (1 major) Nanostructure Technology (2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Physics (2020)</p>		
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Bachelor' degree (1 major) Nanostructure Technology (2020)  
Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
<b>Methods of Non-Destructive Material Testing</b>		11-ZMB-152-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
4	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	undergraduate	--
<b>Contents</b>		
Principles of non-destructive material and component testing. Thermography. Neutron radiography. X-ray testing. Ultrasound. Optical testing, laser. Image processing.		
<b>Intended learning outcomes</b>		
The students have basic knowledge of the generation and interaction processes of different types of radiation (heat, X-ray, terahertz), particles (neutrons) or ultrasound waves with materials. They know the applied methods for the detection of radiation types, particles and ultrasound waves and are able to apply them to basic problems of material testing and characterisation.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (2) + R (1) Module taught in: German or English		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
<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: Once a year, winter semester</p>		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
120 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Bachelor' degree (1 major) Physics (2015) Bachelor' degree (1 major) Nanostructure Technology (2015) Master's degree (1 major) Functional Materials (2016) Bachelor' degree (1 major) Physics (2020) Bachelor' degree (1 major) Nanostructure Technology (2020)		
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Bachelor' degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Functional Materials (2022)  
exchange program Physics (2023)

<b>Module title</b>		<b>Abbreviation</b>
<b>Materials for High Voltage insulation and High Voltage Systems</b>		99-HIS-222-m01
<b>Module coordinator</b>		<b>Module offered by</b>
Dean of the Faculty of Electrical Engineering at the University of Applied Sciences Würzburg-Schweinfurt		University of Applied Sciences Würzburg-Schweinfurt (FHWS)
<b>ECTS</b>	<b>Method of grading</b>	<b>Only after succ. compl. of module(s)</b>
5	numerical grade	--
<b>Duration</b>	<b>Module level</b>	<b>Other prerequisites</b>
1 semester	graduate	--
<b>Contents</b>		
Electrical stress, electrical strength, dielectric material properties, technology and application of insulating materials and systems, diagnostics, measurements, simulation and tests of insulating systems.		
<b>Intended learning outcomes</b>		
The student gain basic knowledge about the electrical field and insulating systems with layering of different materials. They can design simple insulating systems by their own and approve the existing design. They have basic knowledge in the field of diagnosis and technology of insulating materials.		
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)		
V (3) + Ü (1)		
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)		
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes total) Language of assessment: German and/or English		
<b>Allocation of places</b>		
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<b>Additional information</b>		
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<b>Workload</b>		
150 h		
<b>Teaching cycle</b>		
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<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)		
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<b>Module appears in</b>		
Master's degree (1 major) Functional Materials (2022)		