

# Module Catalogue for the Subject

# Nanostructure Technology

as a Bachelor's with 1 major with the degree "Bachelor of Science" (180 ECTS credits)

Examination regulations version: 2012 Responsible: Faculty of Physics and Astronomy

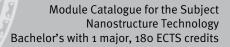


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# The subject is divided into

section / sub-section	ECTS credits	starting page
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### **Content and Objectives of the Programme**

The goal of the studies is it to mediate knowledge on the most important subsections of the Nanostructure Technology and to make the students familiar with the methods of engineering scientific and physical thinking and working. By training of analytic thinking abilities the students acquire the ability to deal later with the various fields of applications and to compile the basic knowledge in particular necessary for a consecutive Bachelor and Master course of studies. Therefore the main emphasis is put on the understanding of the fundamental physical and chemical terms and laws as well as on basic engineering-scientific knowledge and the development of the typical scientific thinking and working structures. During the Bachelor thesis the student should work on an thematic and temporally limited experimental or theoretical engineering-scientific task in the field of Nanostructure Technology using well-known procedures and scientific criteria under guidance to a large extent independently.



### **Abbreviations used**

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

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:

### ASP02009

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

28-Nov-2012 (2012-184) except for mandatory electives added in Fast Track procedure at a later time

04-Nov-2014 (2014-72)

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.



# **Compulsory Courses**

(92 ECTS credits)



# Nanostructure Technology (NP)

(10 ECTS credits)



Module	e title				Abbreviation
Introdu	ıction t	o Nanoscience			11-EIN-092-m01
Module	e coord	inator		Module offered by	·
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
2 seme	ester	undergraduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.		
Conten					
	-	o the principles of produ	cing, characterising a	nd applying nanost	ructures.
		ning outcomes			
		have knowledge of the fur cuctures.	undamental propertie	s, technologies, cha	racterising methods and functi-
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Ger	rman)	
V + S (r	no info	rmation on SWS (weekly	contact hours) and co	urse language avail	lable)
		sessment (type, scope, languable for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether
written otherw			utes, for modules with	less than 4 ECTS cr	redits approx. 90 minutes; unless
Allocat	ion of	olaces			
Only as	part o	f pool of general key skil	ls (ASQ): 15 places. P	laces will be allocat	ed by lot.
Additio	nal inf	ormation			
Worklo	ad				

### 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) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Functional Materials (2012)

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)

No final examination Special study offering (2010)



Module title				Abbreviation	
Advanced Seminar Nanostructure Technology				11-HSN-122-m01	
Module coordinator				Module offered by	
Managing Directors of the Institute of Applied Physics and the Institute of Theoretical Physics and Astrophysics				Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
4	nume	rical grade			
Durati	on	Module level	Other prerequisites		
Admission prerequisite to assessment: regular attendance and cessful preparation of seminar presentation. Certain prerequisit be met to qualify for admission to assessment. The lecturer will students about the respective details at the beginning of the congistration for the course will be considered a declaration of will admission to assessment. If students have obtained the qualific admission to assessment over the course of the semester, the lewill put their registration for assessment into effect. Students will prerequisite will be admitted to assessment in the current of subsequent semester. For assessment at a later date, students with the course of the semester.			tion. Certain prerequisites must sment. The lecturer will inform the beginning of the course. Rered a declaration of will to seek ave obtained the qualification for se of the semester, the lecturer t into effect. Students who meet essment in the current or in the		
Conte	nts	L	100 00000000000000000000000000000000000		
	_	s in advanced topics of r	 nanostructure zechnol	0gV	
		ning outcomes			
		have in-depth knowledg ntly acquire this knowled			ucture technology. They are able ation.
		number of weekly contact hours,			
S (no i	nforma	tion on SWS (weekly cor	ntact hours) and cours	e language available	<u>e</u> )
		<b>sessment</b> (type, scope, langu ble for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether
		30 to 45 minutes) with d assessment: German or E			
Alloca	tion of	places			
Additi	onal inf	ormation			
Workl	oad				
Teachi	Teaching cycle				
	<del></del>				
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in					
Bache	lor' deg	ree (1 major) Nanostruct	ture Technology (2012)	)	



# **Chemistry (CH)**

(10 ECTS credits)



Modul	e title				Abbreviation	
General Chemistry for Physics and Engineers			l Engineers		08-CP1-102-m01	
Modul	e coord	inator		Module offered by		
lecture	lecturer of the course Institute of Ino		Institute of Inorgan	ic Chemistry		
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
10	nume	rical grade				
Durati	on	Module level	Other prerequisites	Other prerequisites		
1 seme	ester	undergraduate				
	_	-				

### **Contents**

This module discusses the fundamental principles of both inorganic and organic chemistry. The lab course gives students the opportunity to learn essential methods and perform simple experiments.

### **Intended learning outcomes**

Students are able to explain the principles of the periodic table and to extract information from it. They are able to explain basic models of the structure of matter. They have developed the ability to use the language of chemical formulas to describe chemical reactions and to interpret them by identifying the type of reaction. They are able to identify fundamental problems in chemistry and perform experiments to solve them.

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

This module comprises 3 module components. Information on courses will be listed separately for each module component.

- 08-IOC-1-072: V (no information on SWS (weekly contact hours) and course language available)
- o8-CP1-3-o72: P (no information on SWS (weekly contact hours) and course language available)
- o8-CP1-1-102: V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component o8-IOC-1-072: Organic Chemistry for students of medicine, biomedicine, dental medicine, engineering and natural science

- 3 ECTS, Method of grading: numerical grade
- written examination (approx. 60 minutes)

**Assessment in module component o8-CP1-3-072:** General and Analytical Chemistry (lab)

- 2 ECTS, Method of grading: (not) successfully completed
- for each experiment: Vortestate (pre-experiment exams, approx. 10 minutes each), assessment of practical performance (log, 2 to 5 pages), Nachtestate (post-experiment exams, approx. 10 minutes each)
- Assessment offered: once a year, summer semester
- Only after successful completion of module components: Successful completion of module component o8-CP1-1 is a prerequisite for participation in module component o8-CP1-3.

**Assessment in module component o8-CP1-1-102:** Principles of Inorganic Chemistry for Physics and Engineering Majors

- 5 ECTS, Method of grading: numerical grade

<ul> <li>written examination (approx. 90 min</li> </ul>	nutes)	
Allocation of places		
Additional information		
Workload		



### 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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)



# **Experimental Physics (EX)**

(32 ECTS credits)



Module	e title				Abbreviation	
	Classical Physics (Mechanics, Thermodynamics, Waves, Oscillations, Electricity, Magnetism and Optics)					
Module	e coord	inator		Module offered by		
Managing Director of the Institute of Applied Physics Faculty of Physic			Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. compl. of module(s)			
16	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
2 seme	ester	undergraduate	Bridge course Mathematische Rechenmethoden der Physik (Mathematical Methods of Physics) for first-semester students.			
Conten	ıts					

Physical laws of mechanics, thermodynamics, vibrations, waves, science of electricity, magnetism, electromagnetic vibrations and waves, radiation and wave optics. Time, room and motion. Physical values. Force and motion. Interactions and central forces. General relativity. Mechanics of rigid bodies. Friction. Vibration and waves. Non-linearity and chaos. Mechanics of non-rigid bodies. Gasses. Thermodynamics. Electrostatics. Electric current. Mechanisms of conduction. Magnetostatics. Electromagnetic induction. Maxwell equations. Science of alternating current. Electromagnetic waves. Geometric optics. Wave optics.

### Intended learning outcomes

The students understand the basic principles and connections of mechanics, thermodynamics, vibrations, waves, science of electricity, magnetism, electromagnetic vibrations and waves, radiation and wave optics. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

Klassische Physik 1 (Mechanik, Wellen, Wärme) (Classical Physics 1 (Mechanics, Waves, Heat)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (winter semester)

Klassische Physik 2 (Elektromagnetismus, Optik) (Classical Physics 2 (Electromagnetism, Optics)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (summer semester)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

This module has the following assessment components

- 1. Topics covered in lectures and exercises in part 1 (Klassische Physik 1 (Classical Physics 1)): written examination (approx. 120 minutes).
- 2. Topics covered in lectures and exercises in part 2 (Klassische Physik 2 (Classical Physics 2)): written examination (approx. 120 minutes).
- 3. Topics covered in lectures and exercises in parts 1 and 2: oral examination of one candidate each (approx. 30 minutes, usually chosen) or written examination (approx. 120 minutes).

Assessment component 3 will be offered in German; English if agreed upon with examiner(s).

Successful completion of approx. 50% of practice work each is a prerequisite for admission to assessment components 1 and 2.

To qualify for admission to assessment component 3, students must pass assessment component 1 and/or 2. Students are highly recommended to attend both courses Klassische Physik 1 (Classical Physics 1) and Klassische Physik 2 (Classical Physics 2). The topics discussed in these two courses will be covered in assessment component 3.

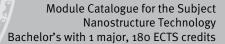
Students must register for assessment components 1 through 3 online (details to be announced).

To pass this module, students must first pass assessment component 1 or 2 and must then pass assessment component 3.

The grade achieved in assessment component 1 or 2 (whichever is better) and the grade achieved in assessment component 3 will each count 50% towards the overall grade awarded for the module.

### **Allocation of places**

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	





### **Additional information**

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### Workload

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### 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) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)

No final examination Special study offering (2010)



Modul	e title	,			Abbreviation	
Condensed Matter (Quanta, Atoms, Molecules, Solid State Physics)			11-KM-092-m01			
Modul	e coord	linator		Module offere	ed by	
Managing Director of the Institute of Applied Physics Fa		Faculty of Phy	Faculty of Physics and Astronomy			
ECTS	Meth	od of grading	Only after succ. o	Only after succ. compl. of module(s)		
16	nume	rical grade				
Durati	on	Module level	Other prerequisit	Other prerequisites		
2 sem	ester	undergraduate				
Conto	ntc	•	•			

### Contents

Quantum phenomena, introduction to Atomic Physics and physical laws of solids. Experimental principles of Quantum Physics. Mathematical formulation of quantum mechanics. Quantum mechanics of hydrogen atoms. Atoms in external fields. Many-electron atoms. Optical transitions and spectroscopy. Laser. Molecules and chemical bonding. Molecule rotations and vibrations. Bonding in crystals. Mechanical properties. Free electron gas (FEG). Crystal structure. The reciprocal lattice. Structure determination. Lattice vibrations (phonons). Thermal properties of insulators. Electrons in a periodic potential.

### **Intended learning outcomes**

The students know the basic contexts and principles of quantum phenomena, Atomic Physics and solids (bonding and structure, lattice dynamics, thermal properties, principles of electronic properties (free electron gas)). They are able to apply mathematical methods to the formulation of modern physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

Kondensierte Materie 1 (Quanten, Atome, Moleküle) (Condensed Matter 1 (Quanta, Atoms, Molecules)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (winter semester)

Kondensierte Materie 2 (Festkörperphysik 1) (Condensed Matter 2 (Solid State Physics)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (summer semester)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

This module has the following assessment components

- 1. Topics covered in lectures and exercises in part 1 (Kondensierte Materie 1 (Condensed Matter 1)): written examination (approx. 120 minutes).
- 2. Topics covered in lectures and exercises in part 2 (Kondensierte Materie 2 (Condensed Matter 2)): written examination (approx. 120 minutes).
- 3. Topics covered in lectures and exercises in parts 1 and 2: oral examination of one candidate each (approx. 30 minutes, usually chosen) or written examination (approx. 120 minutes).

Assessment component 3 will be offered in German; English if agreed upon with examiner(s).

Successful completion of approx. 50% of practice work each is a prerequisite for admission to assessment components 1 and 2.

To qualify for admission to assessment component 3, students must pass assessment component 1 and/or 2. Students are highly recommended to attend both courses Kondensierte Materie 1 (Condensed Matter 1) and Kondensierte Materie 2 (Condensed Matter 2). The topics discussed in these two courses will be covered in assessment component 3.

Students must register for assessment components 1 through 3 online (details to be announced).

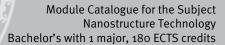
To pass this module, students must first pass assessment component 1 or 2 and must then pass assessment component 3.

The grade achieved in assessment component 1 or 2 (whichever is better) and the grade achieved in assessment component 3 will each count 50% towards the overall grade awarded for the module.

### Allocation of places

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### **Additional information**

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### Workload

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### **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) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



# **Lab Course Physics (PP)**

(13 ECTS credits)

Modules in this area will not factor into the overall grade of the Bachelor's degree.



Module title					Abbreviation	
Lab Course A					11-P-PA-112-m01	
Module coordinator Module offered by						
Managing Director of the Institute of Ap			oplied Physics	Faculty of Physics and Astronomy		
ECTS	Meth	ethod of grading Only after succ.		mpl. of module(s)		
5	(not)	not) successfully completed				
Duration Module level		Other prerequisites				
1 seme	1 semester undergraduate					
Conter	Contents					

Physical laws of mechanics, thermodynamics, science of electricity, types of error, error approximation and propagation, graphs, linear regression, average values and standard deviation, distribution functions, significance tests, writing of lab reports and publications..

### **Intended learning outcomes**

The students know and have mastered physical measuring methods and experimenting techniques. They are able to independently plan and conduct experiments, to cooperate with others, and to document the results in a measuring protocol. They are able to evaluate the measuring results on the basis of error propagation and of the principles of statistics and to draw, present and discuss the conclusions.

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

Auswertung von Messungen und Fehlerrechnung (Measurements and Data Analysis): V (1 weekly contact hour) + Ü (1 weekly contact hour), once a year (winter semester)

Beispiele aus Mechanik, Wärmelehre und Elektrik (Examples from Mechanics, Thermodynamics and Electricity, BAM): P (2 weekly contact hours)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

This module has the following assessment components

- 1. Topics covered in lectures and exercises: written examination (approx. 120 minutes)
- 2. Lab course: a) Preparing, performing and evaluating the experiments will be considered successfully completed if a Testat (exam) is passed. b) Talk (with discussion) to test the students' understanding of the physics-related contents of the course (approx. 30 minutes).

Successful completion of approx. 50% of practice work is a prerequisite for admission to assessment component

To pass assessment component 2, students must pass both elements a) and b). Students will be offered one opportunity to retake element a) and/or element b).

Students must register for assessment components 1 and 2 online (details to be announced).

Students must attend Auswertung von Messungen und Fehlerrechnung (Measurements and Data Analysis) before attending Beispiele aus Mechanik, Wärmelehre und Elektrik (Examples from Mechanics, Thermodynamics and

# To pass this module, students must pass both assessment component 1 and assessment component 2. Allocation of places **Additional information** Workload **Teaching cycle**



### $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

§ 53 (1) 1. a) Physik Mechanik, Wärmelehre, Elektrizitätslehre, Optik, der speziellen Relativitätstheorie

§ 53 (1) 1. c) Physik physikalische Grundpraktika

§ 77 (1) 1. a) Physik "Grundlagen der Experimentalphysik"

§ 77 (1) 1. d) Physik "physikalische Praktika"

### Module appears in

Bachelor' degree (1 major) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)

First state examination for the teaching degree Grundschule Physics (2009)

First state examination for the teaching degree Hauptschule Physics (2009)

First state examination for the teaching degree Realschule Physics (2009)

First state examination for the teaching degree Gymnasium Physics (2009)

First state examination for the teaching degree Mittelschule Physics (2013)



Module	Module title Abbreviation										
Labora	Laboratory Course Nanostructure Technology B 11-P-NB-122-mo1										
Module	Module coordinator Module offered by										
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy						
ECTS	· · · · · · · · · · · · · · · · · · ·										
4	(not)	successfully completed	11-P-PA								
Duration Module level Other prerequisites			Other prerequisites								
1 seme	ster	undergraduate									
Conten	ts										
Physica	al laws	of optics, vibrations and	waves, science of ele	ectricity and circuits	with electric components.						
Intende	ed lear	ning outcomes									
measu princip	le to independently plan and conduct experiments, to cooperate with others, and to document the results in a measuring protocol. They are able to evaluate the measuring results on the basis of error propagation and of the principles of statistics and to draw, present and discuss the conclusions.										
		number of weekly contact hours, I									
P (no ir	P (no information on SWS (weekly contact hours) and course language available)										
	<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)										
a Testa discuss dule co	Preparing, performing and evaluating (lab report) the experiments will be considered successfully completed if a Testat (exam) is passed. Experiments that were not successfully completed can be repeated once. Talk (with discussion; approx. 30 minutes) to test the candidate's understanding of the physics-related contents of the module component. Talks that were not successfully completed can be repeated once. Both components of the assessment have to be successfully completed.										
Allocat	ion of <sub>l</sub>	places									
	<del></del>										
Additio	Additional information										
Workload											
Teachi	Teaching cycle										
	<del></del>										
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)										

Bachelor' degree (1 major) Nanostructure Technology (2012)

Module appears in



Module	Module title Abbreviation						
Advanc	Advanced Laboratory Course Nanostructure Technology C 11-P-NC-122-mo1						
Module	Module coordinator Module offered by						
Managing Director of the Institute of Applied Physics			pplied Physics	Faculty of Physics a	and Astronomy		
ECTS							
4	(not)	successfully completed	11-P-PA and 11-P-NB				
Duration Module level Other prerequisites							
1 seme	ster	undergraduate					
Conten	ts		,				
		of wave optics, Molecula sed devices with exampl			rn measuring methods using spe-		
Intend	ed lear	ning outcomes					
to reco by usin	rd mea ig error	suring results in a structu	ured manner, even in cs. They are able to e	case of huge data tr	rerimental setups. They are able raffic, and to analyse the results raw conclusions and to present		
Course	<b>S</b> (type, r	umber of weekly contact hours, l	anguage — if other than Ger	man)			
P (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	e)		
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether		
a Testa discuss dule co	Preparing, performing and evaluating (lab report) the experiments will be considered successfully completed if a Testat (exam) is passed. Experiments that were not successfully completed can be repeated once. Talk (with discussion; approx. 30 minutes) to test the candidate's understanding of the physics-related contents of the module component. Talks that were not successfully completed can be repeated once. Both components of the assessment have to be successfully completed.						
Allocat	ion of p	olaces	;				
Additio	nal inf	ormation					
Workload							
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	Module appears in						

Bachelor' degree (1 major) Nanostructure Technology (2012)



# Mathematics (M)

(24 ECTS credits)



Module	Module title Abbreviation						
Mathematics 1 and 2 for students in Nanostructure Technology					10-M-NST12-092-m01		
Module coordinator Module offered by							
Dean of Studies Mathematik (Mathematics)			natics)	Institute of Mathematics			
ECTS	Method of grading Only		Only after succ. con	Only after succ. compl. of module(s)			
16	nume	nerical grade					
Duration Module level		Other prerequisites					
2 semester		undergraduate	By way of exception, additional prerequisites are listed in the section assessments.		isites are listed in the section on		
C 4	Contents						

### **Contents**

Basics on numbers and functions, sequences and series, elementary functions, differential and integral calculus in one variable, vector calculus, linear maps and systems of linear equations, matrix calculus, eigenvalue theory, differential and integral calculus in several variables, differential equations, Fourier analysis, integral theorems.

### **Intended learning outcomes**

The student gets acquainted with important concepts of mathematics. He/She learns to apply these methods to simple problems in natural and engineering sciences, in particular in the field of nanostructure technology, and is able to interpret the results.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 10-M-NST12-1-092: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 10-M-NST12-2-092: V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

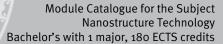
Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

**Assessment in module component 10-M-NST12-1-092:** Mathematics 1 for students of Nanostructure Technology Mathematics 1 for students of Nanostructure Technology

- 8 ECTS, Method of grading: (not) successfully completed
- written examination (approx. 90 to 120 minutes, usually chosen) or oral examination of one candidate each (approx. 20 minutes) or oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Assessment in module component 10-M-NST12-2-092:** Mathematics 2 for students of Nanostructure Technology Mathematics 2 for students of Nanostructure Technology

- 8 ECTS, Method of grading: numerical grade
- written examination (approx. 90 to 120 minutes, usually chosen) or oral examination of one candidate each (approx. 20 minutes) or oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English if agreed upon with the examiner
- Other prerequisites: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will





put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

<u> </u>
Allocation of places
Additional information
Workload
Teaching cycle
Referred to in LPO I (examination regulations for teaching-degree programmes)
——————————————————————————————————————
Module appears in
Bachelor' degree (1 major) Nanostructure Technology (2010)
Bachelor' degree (1 major) Nanostructure Technology (2012)



Module title Abbreviation							
Mathematics 3 for students of Physics and Engineering 11-MPl3-062-m01					11-MPl3-062-m01		
Module coordinator				Module offered by			
Managing Director of the Institute of Theoretical Physics and Astrophysics			of Theoretical Physics	Faculty of Physics and Astronomy			
ECTS	CTS Method of grading Only after succ. compl. of module(s)						
8 numerical grade							
Duration Module level Ot		Other prerequisites	Other prerequisites				
Admission prerequisite to assessment: successful completion o 50% of exercises. Certain prerequisites must be met to qualify for sion to assessment. The lecturer will inform students about the rive details at the beginning of the course. Registration for the course considered a declaration of will to seek admission to assess students have obtained the qualification for admission to assess over the course of the semester, the lecturer will put their registres assessment into effect. Students who meet all prerequisites will mitted to assessment in the current or in the subsequent semestansessment at a later date, students will have to obtain the qualification.				must be met to qualify for admisorm students about the respection. Registration for the course will lek admission to assessment. If an for admission to assessment turer will put their registration for leet all prerequisites will be adnited the subsequent semester. For			
Conto	for admission to assessment anew.  Contents						
		partial differential eq	unations in Physics				
		ning outcomes	uations in Physics.				
The st	udents	<del>-</del>	tical knowledge of dynan	nic equations and so	lution methods for common and		
		•	ours, language — if other than Ge	rman)			
			ekly contact hours) and co		able)		
		sessment (type, scope, la	anguage — if other than German,	examination offered — if no	ot every semester, information on whether		
writter	n exami	nation (approx. 120 n	minutes)				
Alloca	tion of	places					
Additi	onal inf	ormation					
1							
Workle	Workload						
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Bachelor' degree (1 major) Physics (2007) Bachelor' degree (1 major) Physics (2009) Bachelor' degree (1 major) Physics (2008)							

Bachelor' degree (1 major) Technology of Functional Materials (2009) Bachelor' degree (1 major) Technology of Functional Materials (2010)

Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)



Bachelor' degree (1 major) Nanostructure Technology (2008)

Bachelor' degree (1 major) Nanostructure Technology (2007)

Bachelor' degree (1 major) Functional Materials (2012)

Bachelor' degree (1 major) Technology of Functional Materials (2006)



# **Theoretical Physics (TP)**

(16 ECTS credits)

Students interested in participating in the FOKUS programme must take modules 11-TQM-F-2, 11-STE-1 and 11-QSN-P. Module component 11-TQM-F-2, which will prepare students for studying in the Master's programme FOKUS, will be offered in the form of a block course between the lecture periods of the winter and summer semesters (for students who took up studies in winter semester, block course will be offered between third and fourth subject semester).



Module title Abbreviation							
Theoretical Physics for Students of Nanostructure Technology					11-TP-N-122-m01		
Modul	Module coordinator Module offered by						
Managing Director of the Institute of Theoretical Phand Astrophysics			heoretical Physics	Faculty of Physics and Astronomy			
ECTS	Meth	od of grading	Only after succ. co	npl. of module(s)			
16	6 numerical grade						
Duration Module level		Other prerequisites					
2 seme	2 semester undergraduate						
Contor	Contents						

### **Contents**

Physical laws and elementary methods of Theoretical Physics. Mechanics: Newton's laws, physical values and conservation laws, systems of mass points, reference systems, one-dimensional motion, Lagrange equations, applications, Hamiltonian dynamics. Quantum mechanics: Schrödinger equation, one-dimensional quantum mechanics, abstract quantum mechanics (operator formalism), angular momentum, spin. Electrodynamics: Maxwell equations, electrostatics, magnetostatics, dynamics of electromagnetic fields, special relativity. Thermodynamics: Heat, entropy, thermal equilibrium, measurands, level of efficiency, thermodynamic potentials, phase transitions.

### Intended learning outcomes

The students know the basic principles, contexts and elementary methods of Theoretical Physics, theoretical mechanics, quantum mechanics, thermodynamics, electrodynamics and Statistical Physics.

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

Theoretische Physik 1 (Lehramt, Nanostrukturtechnik) (Theoretical Physics 1 (Teaching Degree, Nanostructure Technology)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (summer semester) Theoretische Physik 2 (Lehramt, Nanostrukturtechnik) (Theoretical Physics 2 (Teaching Degree, Nanostructure Technology)): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (winter semester) Statistische Mechanik und Thermodynamik (Statistical Mechanics and Thermodynamics): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (winter semester)

Quantenmechanik (Quantum Mechanics): V (4 weekly contact hours) + Ü (2 weekly contact hours), once a year (summer semester)

Quantenmechanik für FOKUS-Studierende (Quantum Mechanics for FOKUS Students): V (4 weekly contact hours)  $+ \ddot{U}$  (2 weekly contact hours) + T (1 weekly contact hour), once a year (block taught during semester break between summer and winter semester)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

This module has the following assessment components

- 1. Topics covered in lectures and exercises in part 1 (Theoretische Physik 1 (Theoretical Physics 1)): written examination (approx. 120 minutes, usually chosen) or oral examination of one candidate each (approx. 30 minutes).
- 2. Topics covered in lectures and exercises in part 2 (Theoretische Physik 2 (Theoretical Physics 2)): written examination (approx. 120 minutes, usually chosen) or oral examination of one candidate each (approx. 30 minutes).
- 3. Topics covered in lectures and exercises in part 1 (Statistische Mechanik und Thermodynamik (Statistical Mechanics and Thermodynamics)): written examination (approx. 120 minutes, usually chosen) or oral examination of one candidate each (approx. 30 minutes).
- 4. Topics covered in lectures and exercises in part 2 (Quantenmechanik (Quantum Mechanics)): written examination (approx. 120 minutes, usually chosen) or oral examination of one candidate each (approx. 30 minutes).
- 5. Topics covered in lectures and exercises in part 2 (Quantenmechanik für FOKUS-Studierende (Quantum Mechanics for FOKUS Students)): written examination (approx. 120 minutes, usually chosen) or oral examination of one candidate each (approx. 30 minutes).



- 6. Topics covered in lectures and exercises in parts 1 and 2 (assessment in modules Theoretische Physik (Theoretical Physics) 1 and 2): oral examination of one candidate each (approx. 30 minutes, usually chosen) or written examination (approx. 120 minutes).
- 7. Topics covered in lectures and exercises in parts 1 and 2 (assessment in module Theoretische Physik für Studierende der Nanostrukturtechnik (Theoretical Physics for Students of Nanostructure Technology)): oral examination of one candidate each (approx. 30 minutes, usually chosen) or written examination (approx. 120 minutes).

Successful completion of approx. 50% of practice work each is a prerequisite for admission to assessment components 1 through 5.

To qualify for admission to assessment component 6, students must pass assessment component 1 and/or 2. To qualify for admission to assessment component 7, students must pass assessment component 3 and/or 4 and/or 5.

Students are highly recommended to attend both courses Theoretische Physik 1 (Theoretical Physics 1) and Theoretische Physik 2 (Theoretical Physics 2) or, respectively, both courses Statistische Mechanik (Statistical Mechanics) and Thermodynamik und Quantenmechanik (Thermodynamics and Quantum Mechanics). The topics discussed in these courses will be covered in assessment component 6 or, respectively, assessment component 7.

Students must register for assessment components 1 through 7 online (details to be announced).

To pass this module, students must first pass assessment component 1 or 2 and must then pass assessment component 6 or students must first pass assessment component 3, 4 or 5 and must then pass assessment component 7.

The grade achieved in assessment component 1 or 2 (whichever is better) or, respectively, in assessment component 3, 4 or 5 (whichever is the best) and the grade achieved in assessment component 6 or, respectively, assessment component 7 will each count 50% towards the overall grade awarded for the module.

# Allocation of places -Additional information -Workload -Teaching cycle -Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 77 (1) 1. c) Physik "Theoretische Physik"

Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2012)



# **Compulsory Electives**

(30 ECTS credits)

Students interested in participating in the FOKUS programme must take modules 11-TM and 11-ED in the sub-area Theoretische Physik (Theoretical Physics).



# Nanostructure Technology

(ECTS credits)



Module	Module title Abbreviation					
Electronics					11-A2-092-m01	
Module	coord	inator		Module offered by		
Managi	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics and Astronomy		
ECTS Method of grading			Only after succ. con	Only after succ. compl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semester		undergraduate	sessment. The lecturat the beginning of the sidered a declaration dents have obtained the course of the sessment into effect ted to assessment i	rer will inform stude the course. Registrat n of will to seek adm d the qualification fo mester, the lecturer t. Students who mee n the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for	

### Contents

Principles of electronic components and circuits. Analogous circuit technology: Passive (resistors, capacitors, coils and diodes) and active components (bipolar and field-effect transistors, operational amplifiers). Digital circuits: different types of gates and CMOS circuits. Microcontroller

### Intended learning outcomes

The students have knowledge of the practical setup of electronic circuits from the field of analogous and digital circuit technology.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

### Allocation of places

Only as part of pool of general key skills (ASQ): 15 places. Places will be allocated by lot.

### Additional information

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### Workload

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### **Teaching cycle**

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### $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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### Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2011)



Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) FOKUS Physics (2011) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



Module	e title	,			Abbreviation
Semico	Semiconductor Physics and Devices				11-SPD-102-m01
Module	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	graduate	sessment. The lectu at the beginning of t sidered a declaratio dents have obtained the course of the se sessment into effect ted to assessment in	rer will inform stude the course. Registraten of will to seek admed the qualification for mester, the lecturer to students who meen the current or in the date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- r admission to assessment over will put their registration for as- t all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for

Principles of Semiconductor Physics. Introduction to key theories on semiconductors. Components from the areas of electronics and photonics.

# **Intended learning outcomes**

The students are familiar with the properties of semiconductors, they have gained an overview of the electronic and phononic band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport and are able to apply Poisson, Boltzmann and continuity equations to the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the methods of planar technology and current developments in this sector, they have a basic understanding of component production. They understand the structure and function of the main components of electronics (diodes, transistor, FET, thyristor, diac, triac), microwave applications (tunnel, impatt, baritt and Gunn diode) and 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 importance. They are familiar with current developments in the field of components.

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

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 minutes) or oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

# **Allocation of places**

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#### **Additional information**

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Bachelor's with 1 major Nanostructure Technology	JMU Würzburg • generated 26-Aug-2024 • exam. reg. da-	page 37 / 187
(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



# Workload

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# **Teaching cycle**

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

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

Master's degree (1 major) Computational Mathematics (2012)

Master's degree (1 major) Functional Materials (2012)



Module	Module title				Abbreviation
Semico	onducto	or Lasers - Principles and	Current Research		11-HLF-092-m01
Module	coord	linator		Module offered by	
Managi	ing Dire	ector of the Institute of A <sub>l</sub>	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme		graduate	sessment. The lecturation at the beginning of the sidered a declaration dents have obtained the course of the sessment into effect ted to assessment i	ites must be met to qualify for admission to ascurer will inform students about the respective detail of the course. Registration for the course will be contion of will to seek admission to assessment. If stuned the qualification for admission to assessment ov semester, the lecturer will put their registration for as ect. Students who meet all prerequisites will be admit in the current or in the subsequent semester. For as er date, students will have to obtain the qualification	

This lecture discusses the principles of laser physics, based on the example of semiconductor lasers, and current developments regarding components. The principles of lasers are described on the basis of a general laser model, which will then be extended to special aspects of semiconductor lasers. Basic concepts such as threshold condition, characteristic curve and laser efficiency are derived from coupled rate equations for charge carriers and photons. Other topics of the lecture are optical processes in semiconductors, layer and ridge waveguides, laser resonators, mode selection, dynamic properties as well as technology for the generation of semiconductor lasers. The lecture closes with current topics of laser research such as quantum dot lasers, quantum cascade lasers, terahertz lasers or high-performance lasers.

# Intended learning outcomes

The students have advanced knowledge of the principles of semiconductor-laser physics. They can apply their knowledge to modern questions and know the applications in the current development of components.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

location of places	
dditional information	
orkload	



# **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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)

Master's degree (1 major) Functional Materials (2012)



Module	e title				Abbreviation
Semico	onducto	or Nanostructures			11-HNS-092-m01
Module	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	graduate	sessment. The lectu at the beginning of t sidered a declaratio dents have obtained the course of the se sessment into effect ted to assessment in	rer will inform stude the course. Registrat n of will to seek adm the qualification fo mester, the lecturer to Students who meen the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- r admission to assessment over will put their registration for as- t all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for

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, oD). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.

#### **Intended learning outcomes**

The students know the theoretical principles and characteristics of semiconductor nanostructures. They have knowledge of the technological methods to fabricate such structures, and of their applications to novel photonic devices. They are able to apply their knowledge to problems in this field of research.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

# Allocation of places --Additional information --Workload ---



# **Teaching cycle**

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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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Technology of Functional Materials (2010)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)

Master's degree (1 major) Functional Materials (2012)



Module title				Abbreviati	ion	
Quantum Transport in Semiconductor Nanostructures			uctor Nanostructures	11-QTH-10:	2-m01	
Modul	e coord	linator		Module offered by		
Manag	ing Dir	ector of the Institute	e of Applied Physics	Faculty of Physics and Astrono	my	
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
6	nume	erical grade				
Durati	on	Module level	Other prerequisit	Other prerequisites		
1 semester graduate Certain prerequesessment. The at the beginning sidered a decludents have obtained the course of the course of the sessment into the ted to assess the sessment at a sessment are a sessment at a		sessment. The led at the beginning of sidered a declarate dents have obtain the course of the sessment into efforted to assessmen	es must be met to qualify for adminer will inform students about the the course. Registration for the conformit on a set of the qualification for admission emester, the lecturer will put the ct. Students who meet all prerequin the current or in the subsequent date, students will have to obtassement anew.	he respective details course will be conssessment. If stunto assessment over ir registration for asuisites will be admitent semester. For as-		
Conte	nts					
		Ideassas tha fundan	sessment at a late admission to asse	r date, students will have to obta	in the qualificati	

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.

# **Intended learning outcomes**

The students have mastered the basics of electronics of nanostructures in theory and practice. They know functions and applications of respective components.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### Allocation of places

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# Additional information

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# Workload

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# **Teaching cycle**

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Technology of Functional Materials (2010)

Master's degree (1 major) Nanostructure Technology (2011)

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

Master's degree (1 major) Functional Materials (2012)



Module	e title			Abbreviation		
Nanoai	Nanoanalytics			11-NAN-092-m01		
Module	e coord	linator		Module offered by		
Manag	ing Dir	ector of the Institute o	f Applied Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	Other prerequisites		
1 seme	ster	graduate	sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	es must be met to qualify for admission to aster will inform students about the respective details the course. Registration for the course will be control of will to seek admission to assessment. If students are qualification for admission to assessment over emester, the lecturer will put their registration for ast. Students who meet all prerequisites will be admitned the current or in the subsequent semester. For astate, students will have to obtain the qualification for sment anew.		

Principles of analytic procedures in the field of nanostructure physics, imaging techniques from a microscopic level up to an atomic level, examination of chemical composition, spectroscopy of electronic properties, usage of X-ray methods. - Physics and material systems on the nanoscale. - Scanning probes: Atomic force microscopy. Scanning tunneling microscopy. - Electron probes: Scanning electron microscope. - Transmission electron microscope. - Secondary ions - mass spectrometry - X-ray methods: Synchrotron spectroscopy. Photoemission. X-ray absorption

# **Intended learning outcomes**

The students have basic knowledge of modern research methods for different nanostructures up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as spectroscopic methods for the determination of electronic properties. They are able to evaluate the efficiency of different research methods.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

# Allocation of places --Additional information --Workload ---



# **Teaching cycle**

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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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Functional Materials (2012)



Module	e title	·			Abbreviation	
Introdu	ıction t	o Electron Microscopy			11-IEM-111-mo1	
Module	coord	linator		Module offered by		
Manag	ing Dir	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
4	nume	rical grade				
Duratio	n	Module level	Other prerequisites	Other prerequisites		
1 seme	ster	graduate	sessment. The lecturation at the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	ites must be met to qualify for admission to ascurer will inform students about the respective detail of the course. Registration for the course will be contion of will to seek admission to assessment. If stuned the qualification for admission to assessment ov semester, the lecturer will put their registration for assect. Students who meet all prerequisites will be admit in the current or in the subsequent semester. For as er date, students will have to obtain the qualification		

1. Microscopy with light and electrons. 2. Electrons and their interaction with a specimen. 3. Electron diffraction (selected-area ED, convergent beam ED, basics of electron crystallography, comparison with the X-ray diffraction technique). 4. Transmission electron microscopy (the instrument, contrast mechanisms, principles of image formation, imaging of microstructure). 5. Can we see atoms? High-resolution electron microscopy (principle of image formation, image simulation). 6. Scanning electron microscopy (the instrument, contrast mechanisms). 7. Chemical analysis with the electron microscope (energy-dispersive X-ray microanalysis, electron energy loss spectroscopy). 8. Sample preparation. Electron microscopy and complementary techniques.

# **Intended learning outcomes**

The students have basic knowledge of modern research methods of electron microscopy up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as electron-microscopic methods for chemical analysis. They are able to evaluate the efficiency of different research methods.

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

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

Allocation of places
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Additional information
-
Vorkload
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# **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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

Master's degree (1 major) Functional Materials (2012)

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



Module	Module title				Abbreviation
Spintro	onics				11-SPI-102-m01
Module	coord	inator		Module offered by	
Managi	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate	sessment. The lecturat the beginning of the sidered a declaration dents have obtained the course of the sessment into effect ted to assessment i	rer will inform stude the course. Registrat n of will to seek adm the qualification fo mester, the lecturer to Students who meen the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for

This lecture covers the basic principles of spin transport, with a particular emphasis on the phenomena of giant magnetoresistance and tunnel magnetoresistance. As a last point, we discuss new phenomena from the field of spin dynamics and current-induced spin phenomena.

# **Intended learning outcomes**

The students know the basic principles of spin transport models and the applications of spin transport in information technology. They have gained an overview of current findings in this field (giant magnetoresistance, tunnel magnetoresistance).

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

# **Allocation of places**

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# Additional information

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# Workload

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#### Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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



Module	Module title Abbreviation					
Current Topics in Nanostructure Technology					11-BXN5-112-m01	
Module coordinator				Module offered by	l.	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts		,			
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed learı	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this knowication areas.	
V + R (r	no infor	mation on SWS (weekly o	contact hours) and co	urse language avail	able)	
		<b>Sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	_	
Module	e appea	ars in				
	_	ree (1 major) Nanostructu				
Bachel	or' deg	ree (1 major) Nanostructu	ire Technology (2012)			



Module	Module title Abbreviation					
Current Topics in Nanostructure Technology					11-BXN6-112-m01	
Module coordinator				Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed lear	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know-cation areas.	
		mation on SWS (weekly contact nours, t			able)	
a) writti in grou weeks)	en exar ps (app or d) p	le for bonus) mination (approx. 120 mi	nutes) or b) oral exar didate) or c) project ro sentation (approx. 30	nination of one cand eport (approx. 8 to 10	lidate each or oral examination on whether or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
	-					
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	e appea	rs in				
	_	ree (1 major) Nanostructu				
Bachel	or' deg	ree (1 major) Nanostructu	ire Fechnology (2012)	)		



Module	Module title Abbreviation					
Current Topics in Nanostructure Technology					11-BXN8-112-m01	
Module coordinator				Module offered by	J.	
chairperson of examination committee			Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	ıpl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed lear	ning outcomes				
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know- cation areas.	
	-	mation on SWS (weekly o			able)	
		<b>Sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 10	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	appea	ars in				
	_	ree (1 major) Nanostructu				
Bachel	or' deg	ree (1 major) Nanostructu	ire Technology (2012)			



Modul	Module title Abbreviation					
Current Topics in Physics 11-BXP5-112-mod					11-BXP5-112-m01	
Modul	e coord	inator		Module offered by	ı.	
chairpe	erson o	f examination committee	1	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Contents						
		of Experimental and Theversity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intend	ed learı	ning outcomes				
subdis knowle	cipline edge. Th	of Physics and understa ney are able to classify th	nd the measuring and ne subject-specific co	d/or calculation met ntexts and know the	They have knowledge of a current hods necessary to acquire this application areas.	
		number of weekly contact hours,				
V + R (1	no infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project re esentation (approx. 30	eport (approx. 8 to 1	didate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Workload						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Modul	e appea	rs in				



Modul	Module title Abbreviation					
Curren	t Topics	s in Physics		11-BXP6-112-m01		
Modul	e coord	inator		Module offered by	Į.	
chairp	erson o	f examination committee	!	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conter	ıts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intend	ed lear	ning outcomes				
subdis knowle	cipline edge. Th	of Physics and understaney are able to classify th	nd the measuring and e subject-specific co	d/or calculation met ntexts and know the	They have knowledge of a current hods necessary to acquire this application areas.	
		number of weekly contact hours,			112	
		mation on SWS (weekly				
		<b>Sessment</b> (type, scope, langua ble for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
in grouweeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	didate each or oral examination o pages, time to complete: 1 to 4	
Alloca	tion of p	places				
Additio	onal inf	ormation				
Worklo	ad					
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Modul	e appea	ars in				



Module	Module title Abbreviation					
Current	t Topics	s in Physics			11-BXP8-112-m01	
Module	coord	inator		Module offered by		
chairpe	erson o	f examination committee	!	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theore:	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology. I/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	number of weekly contact hours,	language — if other than Ger	rman)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	Workload					
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	e appea	rs in				



# **Energy and Material Science Research**

(ECTS credits)



Modul	e title	,			Abbreviation
Princip	oles of	Energy Technologies			11-ENT-092-m01
Modul	e coord	linator		Module offered by	
Manag	ing Dir	ector of the Institute of A <sub>l</sub>	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 Seme	ester	graduate	sessment. The lecturation at the beginning of the sidered a declaration dents have obtained the course of the sessment into effect ted to assessment i	rer will inform stude the course. Registrat n of will to seek adm d the qualification fo mester, the lecturer t. Students who mee n the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- r admission to assessment over will put their registration for as- t all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for

Physical principles of energy conservation and energy conversion, energy transport and energy storage as well as renewable resources of energy. We also discuss aspects of optimising materials (e.g. nanostructured insulating materials, selective layers, highly activated carbons). The course is especially suitable for teaching degree students. Energy conservation via thermal insulation. Thermodynamic energy efficiency. Fossil fired energy converters. Nuclear power plants. Hydroelectricity. Wind turbines. Photovoltaics. Solar thermal: Heat. Solar thermal: Electricity. Biomass. Geothermal energy. Energy storage. Energy transport

# Intended learning outcomes

The students know the principles of different methods of energy technology, especially energy conversion, transport and storage. They understand the structures of corresponding installations and are able to compare them.

 $\textbf{Courses} \ (\textbf{type}, \, \textbf{number of weekly contact hours, language} - \textbf{if other than German})$ 

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

location of places	
Iditional information	
orkload	
aching cycle	



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

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# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Functional Materials (2012)



Modul	e title				Abbreviation
Nanotechnology in Energy Research					11-NTE-092-m01
Modul	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
4	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 semester graduate		graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.		

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.

# **Intended learning outcomes**

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.

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

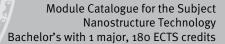
V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Allocation of places	
Additional information	
Workload	
Teaching cycle	





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

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# Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Nanostructure Technology (2011)



Module	e title	,			Abbreviation
Thermodynamics and Economics					11-TDO-092-m01
Module	Module coordinator			Module offered by	
Managing Director of the Institute of Tl and Astrophysics			heoretical Physics	Faculty of Physics and Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semester graduate		sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	trer will inform stude the course. Registrat on of will to seek adm d the qualification fo mester, the lecturer t. Students who mee n the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for	

Energy and economic growth, entropy production, emission reduction. Part I describes the role of energy conversion in the development of the universe, the evolution of life and the unfolding of civilisation. In non-equilibrium thermodynamics, the entropy production density shows the relevance of the second law of thermodynamics for ecological damage and resource consumption. Energy conversion, entropy production and natural resources define the technological and ecological boundaries of industrial economic growth. Part 2 analyses how the factors capital, work, energy and creativity produce the goods and services of a national economy and determine economic growth. The productive power of cheap energy by far exceeds that of expensive labour. Within the current system of taxes and social security contributions, this discrepancy between power and costs of production factors leads to job cuts, waste of resources, impoverishment of nations and growing social tensions. The course discusses how factor income taxation can counteract this development. Part 3 includes seminar presentations, comprises the techniques of rational energy use and non-fossil energy use, and introduces the optimisation programme deeco (Dynamic Energy, Emission and Cost Optimization).

# **Intended learning outcomes**

The students understand that energy conversion and entropy production are going to play an important role in the world's economic and social development. As an extension of economic theory, the students know the connections between thermodynamics and economy as well as the productive physical basis of modern economies. They are able to apply the acquired knowledge to particular problems.

NOTE: this is the module that was run by Prof. Dr. R. Kümmel, who has now retired. As the module was tailored to his own theory of economy, it has yet to be decided whether we will continue to offer this module.

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

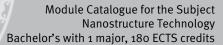
R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English





**Allocation of places** 

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**Additional information** 

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Workload

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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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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



Module	title			Abbreviation	
Introdu	ction t	to Functional Materia	ıls		11-TMS-102-m01
Module	coord	linator		Module offered by	
Managi	ing Dir	ector of the Institute	of Applied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)	
5	nume	erical grade			
Duratio	n	Module level	Other prerequisite	S	
1 semester		undergraduate	sessment. The lect at the beginning of sidered a declarati dents have obtained the course of the sessment into effected to assessment sessment at a later	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification admission to assessment anew.	
Conten	ts				
			s of physical material proles of structuring techno	•	nductor process technology, diel- ting procedures.
Intende	ed lear	ning outcomes			
		have knowledge of the terial synthesis.	ne theoretical and practi	cal principles of phys	ical material properties and tech

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 120 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

# Allocation of places

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# **Additional information**

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# Workload

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# **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) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Functional Materials (2012)



Module title					Abbreviation	
Coatin	g Tech	nologies based on V	apour Deposition		11-BVG-092-m01	
Modul	e coord	dinator		Module offered by		
Manag	ing Dir	ector of the Institute	of Applied Physics	Faculty of Physics	and Astronomy	
ECTS	Meth	od of grading	Only after succ. co	ompl. of module(s)		
5	nume	erical grade				
Duratio	on	Module level	Other prerequisite	Other prerequisites		
1 semester		graduate	sessment. The lector at the beginning of sidered a declarate dents have obtain the course of the sessment into effected to assessment.	turer will inform stude of the course. Registra- ion of will to seek adr ed the qualification for semester, the lecturer ect. Students who med t in the current or in the er date, students will h	ralify for admission to as- ents about the respective details tion for the course will be con- mission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- ne subsequent semester. For as- nave to obtain the qualification fo	

Physical technical principles of PVD and CVD installations and processes. Coating deposit and layer characterisation. Application of layer materials on an industrial level.

# **Intended learning outcomes**

The students have advanced knowledge of coating deposit processes in the gaseous phase and gain insights into their industrial relevance and variety.

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

V + R (no information on SWS (weekly contact hours) and course language available)

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of fered} - \textbf{if not every semester, information on whether} \ \\$ module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

#### Allocation of places

# **Additional information**

# Workload

# **Teaching cycle**

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

# Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor's with 1 major Nanostructure Technology	JMU Würzburg • generated 26-Aug-2024 • exam. reg. da-	page 65 / 187
(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) Functional Materials (2012)



Module coordinator	Modul	e title				Abbreviation
Managing Director of the Institute of Applied Physics   Faculty of Physics and Astronomy	Metho	ds for r	non-destructive Characte	rization of Materials	and Components	11-ZMB-112-m01
Duration   Module level   Other prerequisites	Modul	e coord	inator		Module offered by	
A numerical grade  Duration  Module level  Undergraduate  Certain prerequisites must be met to qualify for admission to assessment. In the Current will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment ove the course of the semester, the lecturer will put their registration for assessment ove the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment at a later date, students will have to obtain the qualification for admission to assessment anew.  Contents  Methods of non-destructive material and component characterisation.  Intended learning outcomes  The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language – if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bours)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes) and course language available on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	Manag	ing Dir	ector of the Institute of Ap	plied Physics	Faculty of Physics a	and Astronomy
Duration Module level Under prerequisites  1 semester  1 semester  1 semester  1 semester  1 semester  1 undergraduate  1 certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment of the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admit ted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.  Contents  Methods of non-destructive material and component characterisation.  Intended learning outcomes  The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours) and course language available)  Method of assessment (type, scope, language — if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for hours)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be amounced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
undergraduate  Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment the course of the semester, the lecturer will put their respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment over the course of the semester, the lecturer will put their respectives will be admit ted to assessment in the current or in the subsequent semester. For assessment in the current or in the subsequent semester. For assessment and a later date, students will have to obtain the qualification admission to assessment anew.  Contents  Methods of non-destructive material and component characterisation.  Intended learning outcomes  The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language – if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination if groups (approx. 30 minutes) per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	4	nume	rical grade			
sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment ove the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification of admission to assessment anew.  Contents  Methods of non-destructive material and component characterisation.  Intended learning outcomes  The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language — if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, soope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	Duratio	on	Module level	Other prerequisites		
Methods of non-destructive material and component characterisation.  Intended learning outcomes  The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language – if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places   Moditional information   Teaching cycle   Referred to in LPO I (examination regulations for teaching-degree programmes)   Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	1 semester  Undergraduate  Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective det at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment the course of the semester, the lecturer will put their registration for sessment into effect. Students who meet all prerequisites will be added to assessment in the current or in the subsequent semester. For sessment at a later date, students will have to obtain the qualification.					
Intended learning outcomes The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language – if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places   Moditional information   Werkload   Teaching cycle   Referred to in LPO 1 (examination regulations for teaching-degree programmes)   Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	Conter	its	ı			
The students know methods of non-destructive characterisation of materials and components.  Courses (type, number of weekly contact hours, language — if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places   Morkload   Teaching cycle   Referred to in LPO I (examination regulations for teaching-degree programmes)   Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	Metho	ds of no	on-destructive material a	nd component charac	cterisation.	
Courses (type, number of weekly contact hours, language – if other than German)  V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	Intend	ed lear	ning outcomes			
V + R (no information on SWS (weekly contact hours) and course language available)  Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	The stu	ıdents	know methods of non-de	structive characterisa	ation of materials an	d components.
Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	Course	S (type, i	number of weekly contact hours, l	anguage — if other than Ger	rman)	
module is creditable for bonus)  a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination i groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes) Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places	V + R (ı	no info	rmation on SWS (weekly o	contact hours) and co	urse language avail	able)
groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 week or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Allocation of places  Morkload  Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)				ge — if other than German, o	examination offered — if no	ot every semester, information on whether
Additional information  Workload  Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	groups or d) p Assess and wi	(approressenta (approsenta (approsent of (approsentation))	ox. 30 minutes per candid ution/seminar presentation offered: When and how of unounced in due form und	late) or c) project repo on (approx. 30 minute ten assessment will l	ort (approx. 10 page es) oe offered depends (	s, time to complete: 1 to 4 weeks) on the method of assessment
Workload Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)	Allocat	ion of	places			
Workload Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)						
Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)	Additio	nal inf	ormation			
Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)						
Referred to in LPO I (examination regulations for teaching-degree programmes)   Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	Worklo	ad				
Referred to in LPO I (examination regulations for teaching-degree programmes)   Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)						
Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)	Teachi	ng cycl	e			
Module appears in  Bachelor' degree (1 major) Nanostructure Technology (2012)  Master's degree (1 major) Nanostructure Technology (2011)						
Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)	Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)	
Bachelor' degree (1 major) Nanostructure Technology (2012) Master's degree (1 major) Nanostructure Technology (2011)						
Master's degree (1 major) Nanostructure Technology (2011)						
	Master	's degr	ee (1 major) Nanostructu	re Technology (2011)	)	



Module tit	le		Abbreviation		
Principles	of two- and threedime	nsional Röntgen imaging	11-ZDR-111-m01		
Module co	ordinator		Module offered by		
Managing	Director of the Institute	of Applied Physics	Faculty of Physics and Astronomy		
ECTS Me	ethod of grading	Only after succ. co	er succ. compl. of module(s)		
6 nu	merical grade				
Duration Module level		Other prerequisite	Other prerequisites		
1 semester graduate		sessment. The lect at the beginning of sidered a declarati dents have obtained the course of the s sessment into effe	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.		

Physics of X-ray generation (X-ray tubes, synchrotron). Physics of the interaction between X-rays and matter (photon absorption, scattering), physics of X-ray detection. Mathematics of reconstruction algorithms (filtered rear projection, Fourier reconstruction, iterative methods). Image processing (image data pre-processing, feature extraction, visualisation,...). Applications of X-ray imaging in the industrial sector (component testing, material characterisation, metrology, biology, ...). Radiation protection and biological radiation effect (dose, ...).

#### **Intended learning outcomes**

The students know the principles of generating X-rays and of their interactions with matter. They know imaging techniques using X-rays and methods of image processing as well as application areas of these methods.

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

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

#### Allocation of places

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# Additional information

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# Workload

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#### Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

Master's degree (1 major) Functional Materials (2012)

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



at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For as	Module	e title			Abbreviation		
Managing Director of the Institute of Applied Physics  Method of grading  Only after succ. compl. of module(s)   Duration  Module level  1 semester  Graduate  Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment ow the course of the semester, the lecturer will put their registration for as sessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For as	Applie	d Supe	rconduction		11-ASL-092-m01		
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment in the current or in the subsequent semester.	Module	e coord	linator		Module offered by		
Duration Module level Other prerequisites  1 semester graduate Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment in the current or in the subsequent semester.	Manag	ing Dir	ector of the Institute	of Applied Physics	Faculty of Physics and Astronomy		
Duration  Module level  Gertain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment in the current or in the subsequent semester.	ECTS	Meth	od of grading	Only after succ. c			
graduate  Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment in the current or in the subsequent semester.	6	nume	rical grade				
sessment. The lecturer will inform students about the respective detail at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For as	Duratio	on	Module level	Other prerequisit	Other prerequisites		
admission to assessment anew.			sessment. The led at the beginning of sidered a declaral dents have obtain the course of the sessment into eff ted to assessment sessment at a late	sessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for			

Physical principles of superconductivity. Application in energy engineering. Instrumental developments. Methods of materials sciences for the calculation of temperature profiles in superconductors.

# **Intended learning outcomes**

The students have a basic understanding of superconductivity as a macroscopic quantum phenomenon. They are able to evaluate the contributions of materials sciences to the development of superconductivity. They are able to discuss questions on superconductivity in a scientific manner and to critically question developments of energy technology. Furthermore, they can deal with practical mathematical questions.

 $\textbf{Courses} \ (\textbf{type}, \, \textbf{number of weekly contact hours, language} - \textbf{if other than German})$ 

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: once a year, winter semester Language of assessment: German, English

# Allocation of places

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# **Additional information**

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#### Workload

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# **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) Physics (2010)

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Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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



Module	title				Abbreviation	
Electro	chemic	al Energy Storage and	Conversion		08-EEW-122-m01	
Module	coord	inator		Module offered by	1	
holder thesis	of the (	Chair of Chemical Techr	nology of Material Syn-	Chair of Chemical	Technology of Material Synthesis	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semester graduate Admission prerequisite to assessment: regular attendance of lab course (a maximum of one incident of unexcused absence).						
Conten	ts					
um and cal dou	l nickel ıble lay	metal hydride, sodium	sulphur, sodium nicke w batteries, fuel cell sy	el chloride, lithium vstems (AFC, PEMFC	tems such as lead, nickel cadmi- ion accumulators), electrochemi- C, DMFC, PAFC, SOFC), solar cells	
Intende	ed lear	ning outcomes				
		e developed a knowledge to research problems		nergy storage and	conversion and are able to apply	
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ger	rman)		
V + P +	F (no i	nformation on SWS (we	ekly contact hours) and	d course language :	availahle)	

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 5 pages) and 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). Should a module component comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise specified; should the lecturer want to make changes to the way in which assessments are weighted, he or she must do so by two weeks after the start of the course at the latest and must communicate this to students in an appropriate manner.

# **Allocation of places**

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# **Additional information**

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# Workload

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#### Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for tea} \underline{\text{ching-degree programmes}})$ 

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# Module appears in

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



Module title					Abbreviation	
Molecular Materials (Lecture and practical course)					08-CT-122-m01	
Module coordinator				Module offered by		
Dean o	f Studi	es Funktionswerkstoffe (l	Functional Materials)	Chair of Chemical T	echnology of Material Synthesis	
ECTS	Meth	od of grading	Only after succ. com	mpl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 semester		undergraduate	By way of exception, additional prerequisites are listed in the section on assessments.			
Contents						

This module discusses the theoretical and practical principles of molecular and soft materials.

### **Intended learning outcomes**

Students have developed a knowledge of the principles of molecular and soft materials and are able to apply that knowledge to research problems.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 08-CT-1-122: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 08-CT-2-122: P (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

### **Assessment in module component o8-CT-1-122:** Molecular Materials (Lecture) Molecular Materials (Lecture)

- 5 ECTS, Method of grading: numerical grade
- presentation (approx. 30 minutes) and a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes). Should a module component comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise specified; should the lecturer want to make changes to the way in which assessments are weighted, he or she must do so by two weeks after the start of the course at the latest and must communicate this to students in an appropriate manner.
- Language of assessment: German or English
- Other prerequisites: Admission prerequisite to assessment: successful completion of exercises in the
  respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully
  completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused
  absence).

### **Assessment in module component o8-CT-2-122:** Molecular Materials (Practical course)

- 5 ECTS, Method of grading: (not) successfully completed
- Vortestate (pre-experiment exams, approx. 15 minutes each) and logs (approx. 5 pages each)
- Assessment offered: once a year, winter semester
- Language of assessment: German or English
- Other prerequisites: Admission prerequisite to assessment: regular attendance (minimum 80%) of courses.

### Allocation of places

Information on the allocation of places will be listed separately for each module component.

• 08-CT-1-122: --

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• o8-CT-2-122: Students from the Faculty of Chemistry: no restrictions. Nanostrukturtechnik (Nanostructure Technology): 4. Should there be more than 4 applications from students of Nanostrukturtechnik (Nanostructure Technology), places will be allocated among these applicants as follows: (1) Places will be allocated by lot. (2) 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 a standardised 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. (3) A waiting list will be maintained and places re-allocated as they become available.

maintained and places te attocated as they become available.
Additional information
Workload
Teaching cycle
Referred to in LPO I (examination regulations for teaching-degree programmes)
Module appears in
Bachelor' degree (1 major) Nanostructure Technology (2012)
Bachelor' degree (1 maior) Functional Materials (2012)



Module title Abbreviation							
Moleci	Molecular Materials for Students of Nanostructure Technology 08-CTO-122-mo1						
Modul	e coord	inator		Module offered by			
Dean c	of Studi	es Funktionswerkstoffe (	Functional Materials)	Chair of Chemical T	echnology of Material Synthesis		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
5	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ester	undergraduate	Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).				
Conter	ıts						
This m	odule d	iscusses the theoretical	and practical princip	es of molecular and	soft materials.		
Intend	ed lear	ning outcomes					
		e developed a knowledge ge to research problems.	e of the principles of r	nolecular and soft m	naterials and are able to apply		
Course	<b>es</b> (type, r	number of weekly contact hours,	language — if other than Ger	man)			
V + Ü (	no info	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)		
		<b>sessment</b> (type, scope, langua le for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether		
2 writte oral ex prox. 3 will be which and me	en exan aminat o minu equally assessi ust com	ninations: approx. 60 or ion of one candidate eac tes). Should a module co weighted, unless other	90 minutes each; 3 with (approx. 20 minute omponent comprise mise specified; should or she must do so by the in an appropriate mise.	ritten examinations: s) or c) oral examina nore than one graded d the lecturer want to wo weeks after the s	examination: approx. 90 minutes; approx. 60 minutes each) or b) ation in groups (groups of 2, apd assessment, all assessments o make changes to the way in start of the course at the latest		
	tion of p						
			_				
Additio	onal inf	ormation	_				
Worklo	oad		_				
	<del></del>						
Teachi	ng cycl	e					
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
		,					
Modul	e appea	ars in					



Module title					Abbreviation	
Chemically and bio-inspired Nanotechnology for Material S				Synthesis	08-NT-122-m01	
Module	e coord	inator		Module offered by		
holder of the Chair of Chemical Technology of Material Synthesis			ology of Material Syn-	Chair of Chemical Technology of Material Synthesis		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duration Module level		Other prerequisites				
1 semester graduate						
Conten	Contents					

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. It also discusses the fundamental principles of biomineralisation and uses examples to introduce students to bio-inspired material synthesis.

### **Intended learning outcomes**

Students have developed an advanced knowledge of sol-gel chemistry and biomineralisation.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 08-NT-1-122: V (no information on SWS (weekly contact hours) and course language available)
- 08-NT-2-122: V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

### **Assessment in module component o8-NT-1-122:** Sol-Gel Chemistry 1: Fundamentals

- 2 ECTS, Method of grading: numerical grade
- a) written examination (approx. 45 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

Assessment in module component o8-NT-2-122: From Biomineralisation to biologically inspired Materials Synthesis

- 3 ECTS, Method of grading: numerical grade
- a) written examination (approx. 45 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

### **Allocation of places Additional information** Workload **Teaching cycle Referred to in LPO I** (examination regulations for teaching-degree programmes) Modulo appears in

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Bachelor' degree (1 major) Functional Materials (2012)

Master's degree (1 major) Chemistry (2013)

Master's degree (1 major) Technology of Functional Materials (2010)

Master's degree (1 major) Technology of Functional Materials (2009)

Master's degree (1 major) Functional Materials (2012)



Module title					Abbreviation
Nanoso	cale Ma	terials			08-PCM3-102-m01
Module	e coord	inator		Module offered by	
lecture	lecturer of the seminar "Nanoskalige Materialien"			Institute of Physical and Theoretical Chemistry	
ECTS	Metho	od of grading	Only after succ. compl. of module(s)		
5	nume	rical grade			
Duratio	Duration Module level		Other prerequisites		
1 seme	1 semester graduate				
Contents					

This module discusses advanced topics in nanoscale materials. It focuses on the structure, properties, fabrication, modern characterisation methods and application areas of nanoscale materials.

### **Intended learning outcomes**

Students are able to characterise nanoscale materials. They are able to name analytical methods and application areas of nanoscale materials.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (90 minutes) or oral examination of one candidate each (20 minutes) or talk (30 minutes) Language of assessment: German or English

### Allocation of places

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### **Additional information**

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### Workload

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### **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) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Chemistry (2013)

Master's degree (1 major) Chemistry (2010)

Master's degree (1 major) Chemistry (2014)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Computational Mathematics (2012)

Master's degree (1 major) Functional Materials (2012)



Module	Module title Abbreviation							
Material Science 1 (basic introduction) 08-FS1-122-mo1								
Module coordinator Module offered by					I.			
Dean o	f Studie	es Funktionswerkstoffe (I	Functional Materials)	Chair of Chemical T	echnology of Material Synthesis			
ECTS	Metho	od of grading	Only after succ. con	ipl. of module(s)				
5	nume	rical grade						
Duratio	on	Module level	Other prerequisites					
1 seme	ster	graduate						
Conter	ıts							
		iscusses the fundamentarties of materials.	al relations between	chemical bonding, tl	he structure, the microstructure			
Intend	ed learı	ning outcomes						
	tructure				al bonding, the structure, the to apply them to research pro-			
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)				
V + Ü (	no infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)			
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether			
or 90 n each (a	ninutes approx.		tions: approx. 60 mir amination in groups	utes each) or b) ora	tten examinations: approx. 60 l examination of one candidate . 30 minutes)			
Allocat	ion of p	olaces						
Additio	onal inf	ormation						
Worklo	ad							
Teachi	Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)								
Module appears in								
		ree (1 major) Nanostructu	ıre Technology (2012)					
Bachel	Bachelor' degree (1 major) Functional Materials (2012)							
11	Masteria dagrae (4 major) Chemistry (2010)							

Master's degree (1 major) Chemistry (2013)



Module title					Abbreviation	
Material Science 2 (the material groups)					08-FS2-122-m01	
Modul	e coord	inator		Module offered by		
Dean c	f Studi	es Funktionswerkstoffe (F	unctional Materials)	Chair of Chemical T	echnology of Material Synthesis	
ECTS	Metho	od of grading	Only after succ. con	ipl. of module(s)		
5	nume	rical grade				
Duration	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	ıts					
This m	odule d	eals with the fabrication	and properties of the	main material grou	ps.	
Intend	ed lear	ning outcomes				
		e developed a knowledge knowledge to research pr		d properties of the n	nain material groups and are able	
Course	<b>es</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V + Ü (	no info	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
a) 1 to or 90 r each (a	s creditab 3 writte ninutes approx.	le for bonus) n examinations (1 writter	n examination: appro tions: approx. 6o mir amination in groups	x. 90 minutes; 2 writ	tevery semester, information on whether ten examinations: approx. 60 l examination of one candidate . 30 minutes)	
	tion of p					
Additio	onal inf	ormation				
Worklo	oad					
	-					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
	_	ree (1 major) Nanostructu	•,			
	_	ree (1 major) Functional M				
Maste	Master's degree (1 major) Chemistry (2013)					



Module	Module title				Abbreviation
Chemical Nanotechnology: Analytics and Applications					08-FS5-101-m01
Module coordinator				Module offered by	
holder thesis	holder of the Chair of Chemical Technology of Material Synthesis			Chair of Chemical Technology of Material Synthesis	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duration Module level		Other prerequisites			
1 semester graduate					
Contents					

The module provides an application-oriented introduction to the characterisation methods of nanochemistry and includes practical exercises. It also discusses thermoanalysis, rheological processes and dynamic light scattering. The lecture also offers insights into the applications of nanomaterials in the industrial and technological sectors.

### **Intended learning outcomes**

Students have developed an advanced knowledge of sol-gel chemistry and biomineralisation.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- o8-FS5-1-101: V (no information on SWS (weekly contact hours) and course language available)
- o8-FS5-2-101: V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

### Assessment in module component o8-FS5-1-101: Sol-Gel Chemistry 2

- 2 ECTS, Method of grading: numerical grade
- a) oral examination (approx. 15 minutes) or b) written examination (approx. 45 minutes)

Assessment in module component o8-FS5-2-101: Application oriented Characterization of colloidal and polymeric systems

- 3 ECTS, Method of grading: numerical grade
- a) oral examination (approx. 20 minutes) or b) written examination (approx. 45 minutes)

### Allocation of places

Number of places: 20. Should the number of applications exceed the number of available places, places will be allocated in a standardised procedure among all applicants irrespective of their subjects according to the following quotas: Quota 1 (50% of places): total number of ECTS credits already achieved in the respective degree subject; 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): allocation by lot. In this procedure, applicants who already have successfully completed at least one 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.

### Additional information

The course is offered as a block course at the end of the semester.

### Workload

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### 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) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Technology of Functional Materials (2010)

Master's degree (1 major) Functional Materials (2012)



Module	Module title Abbreviation							
Current Topics in Nanostructure Technology 11-BXN5-112-mo1								
Module	e coord	inator		Module offered by				
	_	f examination committee		Faculty of Physics a	and Astronomy			
ECTS		od of grading	Only after succ. con	· · · · · · · · · · · · · · · · · · ·	,			
5	1	rical grade		•				
Duratio	on	Module level	Other prerequisites					
1 seme	ester	undergraduate	Approval by examin	ation committee req	uired.			
Conten	nts							
	t topics ly abroa		. Accredited academi	c achievements, e.g.	. in case of change of university			
Intend	ed lear	ning outcomes						
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this know-ication areas.			
	_	rmation on SWS (weekly o			able)			
		<b>sessment</b> (type, scope, langua ble for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether			
in grou weeks)	ıps (apı ) or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4			
	tion of <sub>I</sub>	-						
Additio	onal inf	ormation						
Worklo	oad							
Teachi	Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)								
Module	e appea	ars in						
	Bachelor' degree (1 major) Nanostructure Technology (2010)							
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)							



Module	e title				Abbreviation
Current	t Topics	s in Nanostructure Techn	ology		11-BXN6-112-m01
Module	e coord	inator		Module offered by	l .
chairperson of examination committee			Faculty of Physics a	and Astronomy	
ECTS Method of grading		Only after succ. con	pl. of module(s)		
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.
Conten	ts				
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university
Intend	ed lear	ning outcomes			
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this knowication areas.
		mation on SWS (weekly o			able)
		<b>Gessment</b> (type, scope, langua le for bonus)	ge — if other than German, (	examination offered — if no	ot every semester, information on whether
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4
Allocat					
Additio	nal inf	ormation			
Worklo	ad				
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
	_	ree (1 major) Nanostructu			
Bachel	or' deg	ree (1 major) Nanostructu	ire Technology (2012)		



Module	e title				Abbreviation
Curren	t Topic	s in Nanostructure Techn	ology		11-BXN8-112-m01
Module	e coord	inator		Module offered by	
	chairperson of examination committee			Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con	· · · · · · · · · · · · · · · · · · ·	•
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate	Approval by examin	ation committee req	uired.
Conten	nts				
	t topics ly abroa		. Accredited academi	c achievements, e.g.	. in case of change of university
Intend	ed lear	ning outcomes			
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	odiscipline of nanostructure techs s necessary to acquire this know- ication areas.
	_	mation on SWS (weekly o			able)
module is	s creditab	le for bonus)			ot every semester, information on whether
in grou weeks)	ıps (app ) or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	o pages, time to complete: 1 to 4
Allocat	tion of p	olaces			
Additio	onal inf	ormation			
Worklo	oad				
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
	_	ree (1 major) Nanostructu	•, .		
Bachel	lor' deg	ree (1 major) Nanostructu	ire Fechnology (2012)	)	



Module	e title				Abbreviation
Thermodynamics and Economics					11-TDOE-141-mo1
Module coordinator				Module offered by	
Managing Director of the Institute of Th and Astrophysics			neoretical Physics	Faculty of Physics and Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
3	(not)	successfully completed			
Duration Module level		Other prerequisites			
1 semester graduate					
Conten	Contents				

Energy and economic growth, entropy production, emission reduction.

Part I describes the role of energy conversion in the development of the universe, the evolution of life and the unfolding of civilisation. The entropy production density of non-equilibrium thermodynamics shows the relevance of the second law of thermodynamics for ecological damage and resource consumption. Energy conversion, entropy production and natural resources define the technological and ecological boundaries of industrial economic growth.

Part 2 analyses how the factors capital, work, energy and creativity produce the goods and services of a national economy and determine economic growth. The productive power of cheap energy by far exceeds that of expensive labour. Within the current system of taxes and social security contributions, this discrepancy between power and costs of production factors leads to job cuts, waste of resources, impoverishment of nations and growing social tensions. The course discusses how factor income taxation can counteract this development.

Part 3 includes seminar presentations, comprises the techniques of rational energy use and non-fossil energy use, and introduces the optimisation programme deeco (Dynamic Energy, Emission and Cost Optimization).

### Intended learning outcomes

The students understand that energy conversion and entropy production are going to play an important role in the world's economic and social development. As an extension of economic theory, the students know the connections between thermodynamics and economy as well as the productive physical basis of modern economies. They are able to apply the acquired knowledge to particular problems.

NOTE: this is the module that was run by Prof. Dr. R. Kümmel, who has now retired. As the module was tailored to his own theory of economy, it has yet to be decided whether we will continue to offer this module.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

V (no information on SWS (weekly contact hours) and course language available)

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language}) \ (\textbf{type}, \textbf{language}) \$ module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

### Allocation of places

### Additional information

### Workload

### Teaching cycle

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

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



### Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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



Module title Abbreviation					
mage and S	ignal Processing in F	Physics	11-BSV-122-m01		
Module coordinator			Module offered by		
Managing Director of the Institute of Applied Physics			Faculty of Physics and Astronomy		
ECTS Meti	hod of grading	Only after succ. c	ompl. of module(s)		
6 num	erical grade				
Duration	Module level	Other prerequisit	Other prerequisites		
semester	graduate	sessment. The led at the beginning of sidered a declarated dents have obtain the course of the sessment into eff ted to assessmen	sites must be met to qualify for admission to ascurer will inform students about the respective details of the course. Registration for the course will be concation of will to seek admission to assessment. If stuined the qualification for admission to assessment over a semester, the lecturer will put their registration for asfect. Students who meet all prerequisites will be admitnt in the current or in the subsequent semester. For aster date, students will have to obtain the qualification for		

Periodic and aperiodic signals; principles of discreet and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parsival theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.

### **Intended learning outcomes**

The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.

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

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

### Allocation of places

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### Additional information

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### Workload

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### **Teaching cycle**

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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### Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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



Module title Abbreviation					
Topics	in Physics			11-BXP5-112-m01	
coordi	inator		Module offered by		
chairperson of examination committee			Faculty of Physics a	and Astronomy	
ECTS Method of grading Only after succ.		Only after succ. con	pl. of module(s)		
numer	ical grade				
Duration Module level Other prerequisites					
ter	undergraduate	Approval by examin	ation committee req	uired.	
s					
		eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
d learr	ing outcomes				
cal Ph ipline Ige. Th	ysics of the Bachelor's p of Physics and understa ey are able to classify th	rogramme of Nanosti nd the measuring and le subject-specific co	ructure Technology.  I/or calculation method intexts and know the	They have knowledge of a current hods necessary to acquire this	
(type, n	umber of weekly contact hours,	language — if other than Ger	man)		
infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		nge — if other than German, o	examination offered — if no	ot every semester, information on whether	
s (app or d) p	rox. 30 minutes per can resentation/seminar pre	didate) or c) project resentation (approx. 30	eport (approx. 8 to 10		
on of p	laces				
al info	ormation				
d					
g cycle	2				
l to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
appea	rs in				
	coording son of Method numer so son of universe so funive dents he cal Pheno informof assereditable nexares (apport d) per of asserted table nexares (apport d) per	coordinator son of examination committee Method of grading numerical grade Module level ter undergraduate scopics of Experimental and Theof university or study abroad. Id learning outcomes lents have advanced competer cal Physics of the Bachelor's pline of Physics and understate. They are able to classify the (type, number of weekly contact hours, or information on SWS (weekly of assessment (type, scope, languate and preditable for bonus) In examination (approx. 120 minus (approx. 30 minutes per cannot d) presentation/seminar preditable for bonus. In examination (approx. 120 minus (approx. 30 minutes per cannot d) presentation/seminar preditable for bonus. In examination (approx. 120 minus (approx. 120 minu	Topics in Physics  coordinator  son of examination committee  Method of grading numerical grade  in Module level ter undergraduate  Approval by examin  stopics of Experimental and Theoretical Physics. According university or study abroad.  Id learning outcomes  lents have advanced competencies corresponding to cal Physics of the Bachelor's programme of Nanostropline of Physics and understand the measuring and ge. They are able to classify the subject-specific contitype, number of weekly contact hours, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment: German or English  on of places  lat information  d  to in LPO I (examination regulations for teaching-degree programation LPO I (examination regulations for teaching-degree programatical progra	Topics in Physics  coordinator  son of examination committee  Method of grading  numerical grade  Module level  In Module level  Other prerequisites  ter undergraduate  Approval by examination committee requirents of university or study abroad.  It learning outcomes  lents have advanced competencies corresponding to the requirements and Physics of the Bachelor's programme of Nanostructure Technology. pline of Physics and understand the measuring and/or calculation metige. They are able to classify the subject-specific contexts and know the (type, number of weekly contact hours, language — if other than German)  Information on SWS (weekly contact hours) and course language avail of assessment (type, scope, language — if other than German, examination of freed — if no reditable for bonus)  In examination (approx. 120 minutes) or b) oral examination of one cance or d) presentation/seminar presentation (approx. 30 minutes)  In of places  It in LPO 1 (examination regulations for teaching-degree programmes)	



Module	title	,			Abbreviation	
Current	Topics	s in Physics			11-BXP6-112-m01	
Module	coord	inator		Module offered by		
chairperson of examination committee				Faculty of Physics a	and Astronomy	
ECTS Method of grading Only after succ.		Only after succ. con	npl. of module(s)			
6	nume	rical grade				
Duration Module level Other prerequisites						
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and Theversity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theores subdis- knowle	tical Ph cipline dge. Th	ysics of the Bachelor's p of Physics and understa ney are able to classify th	rogramme of Nanosti nd the measuring and le subject-specific co	ructure Technology.  I/or calculation metl  ntexts and know the	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	umber of weekly contact hours,	language — if other than Ger	man)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	nge — if other than German, o	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	appea	rs in				



Module	Module title Abbreviation					
Current	Topics	s in Physics			11-BXP8-112-m01	
Module	coord	inator		Module offered by		
chairperson of examination committee			?	Faculty of Physics a	and Astronomy	
ECTS Method of grading Only after succ. co		Only after succ. con	ipl. of module(s)			
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examination committee required.			
Conten	ts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theoret subdisc	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology.  I/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	number of weekly contact hours,	language — if other than Ger	man)		
V + R (n	o infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		<b>sessment</b> (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	a) written examination (approx. 120 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Language of assessment: German or English					
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teachir	Teaching cycle					
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	appea	ars in				



Module	e title			Abbreviation			
Image	and Sig	gnal Processing in P	hysics		11-BSV-131-m01		
Module coordinator				Module offered by	I.		
Manag	ing Dir	ector of the Institute	of Applied Physics	Faculty of Physics a	and Astronomy		
ECTS	Meth	od of grading	Only after succ. co	npl. of module(s)			
6	6 numerical grade						
Duratio	on	Module level	Other prerequisites	ther prerequisites			
1 seme	graduate  Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semesters.						
Conten	ts						
and im	age pro	ocessing; discretisat	ion of signals/sampling t	heorem (Shannon);	mation; principles of digital sign homogeneous and linear filters,		

Periodic and aperiodic signals; principles of discreet and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parsival theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.

### **Intended learning outcomes**

The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### **Allocation of places**

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### Additional information

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### Workload

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### Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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### Module appears in

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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



Modul	e title	'	Abbreviation			
Physics of Advanced Materials					11-PMM-132-m01	
Module coordinator Module offered by						
Manag	ing Dire	ector of the Institute	of Applied Physics	pplied Physics Faculty of Physics and Astronomy		
ECTS	Method of grading Only after succ.			com	ıpl. of module(s)	
6 numerical grade						
Duration Module level		Other prerequisi	Other prerequisites			
1 semester graduate						

General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.

### **Intended learning outcomes**

The students know the properties and characterising methods of some modern materials.

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

V + R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### Allocation of places

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### **Additional information**

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### Workload

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### **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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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



### **Life Science**

(ECTS credits)



Module title				Abbreviation	
Biophysical Measurement Technology in Medical Science				<b>e</b> 11-BMT-092-m01	
Module coordinator				Module offered by	
Managing Director of the Institute of Applied Physics			of Applied Physics	Faculty of Physics and Astronomy	
ECTS	Meth	od of grading	Only after succ. c	Only after succ. compl. of module(s)	
6	nume	rical grade			
Duration Module level		Other prerequisit	Other prerequisites		
1 semester		graduate	sessment. The led at the beginning of sidered a declarated dents have obtain the course of the sessment into eff ted to assessmen	ites must be met to qualify for admission to as- cturer will inform students about the respective details of the course. Registration for the course will be con- tion of will to seek admission to assessment. If stu- ned the qualification for admission to assessment over semester, the lecturer will put their registration for as- ect. Students who meet all prerequisites will be admit- at in the current or in the subsequent semester. For as- er date, students will have to obtain the qualification for essment anew.	

The lecture covers the physical principles of imaging techniques and their application in Biomedicine. The main topics are conventional X-ray technique, computer tomography, imaging techniques of nuclear medicine, ultrasound and MR-tomography. The lecture additionally addresses systems theory of imaging systems and digital image processing.

### **Intended learning outcomes**

The students know the physical principles of imaging techniques and their application in Biomedicine. They understand the principles of image generation and are able to explain different techniques and interpret simple images.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### **Allocation of places**

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### **Additional information**

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### Workload

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### **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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Functional Materials (2012)



Module	e title				Abbreviation
Laboratory and Measurement Technology in Biophysics					11-LMB-092-m01
Module coordinator				Module offered by	
Manag	ing Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. compl. of module(s)		
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semester		graduate	sessment. The lecturate the beginning of the sidered and declaration dents have obtained the course of the sessment into effect ted to assessment in the lecture.	rer will inform stude the course. Registrat n of will to seek adm the qualification fo mester, the lecturer to Students who meen the current or in th date, students will h	alify for admission to as- nts about the respective details ion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification for

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.

### **Intended learning outcomes**

The students know the principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. They have knowledge of optical measuring techniques and their applications and are able to apply techniques of structure elucidation to simple biomolecules.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

<u> </u>
Allocation of places
Additional information
Workload
Teaching cycle



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

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### Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Functional Materials (2012)



Module title					Abbreviation	
Functional Biomaterials for Students of Nanostructure Technology and Science					03-NS-FBM-102-m01	
Module coordinator Mod				Module offered by		
1	holder of the Chair of Functional Materials in Medicine and Dentistry			Faculty of Medicine		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duration Module level Oth		Other prerequisites				
1 semester undergraduate						
Conter	Contents					

Fundamental principles and specific knowledge for working in natural and engineering sciences in the field of biomaterials with surface modification and characterisation.

### **Intended learning outcomes**

Students have developed an advanced knowledge in at least one application area or technology focus of engineering work, with a particular focus on biomedical materials.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 03-NS-FBM-1-102: V (no information on SWS (weekly contact hours) and course language available)
- o3-NS-FBM-2-102: V + P (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component og-NS-FBM-1-102: Functional Biomaterials for Students of Nanostructure Technology and Science

- 3 ECTS, Method of grading: numerical grade
- written examination (approx. 90 to 120 minutes) or oral examination of one candidate each or oral examination in groups (approx. 30 minutes)

Assessment in module component o3-NS-FBM-2-102: Special Topics in Functional Biomaterials Special Topics in **Functional Biomaterials** 

- 2 ECTS, Method of grading: (not) successfully completed
- placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 to 20 pages)

report / report on teerment course (approx. To to 20 pages)
Allocation of places
Additional information
Workload
Teaching cycle
Referred to in LPO I (examination regulations for teaching-degree programmes)
Module appears in



Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)



Module title					Abbreviation
Biotech	nolog	y 1 for Nanostructure Tec		07-4BFMZ5N-102-m01	
Module coordinator				Module offered by	
holder of the Chair of Biotechnology				Faculty of Biology	
ECTS	S Method of grading Only		Only after succ. con	Only after succ. compl. of module(s)	
5	nume	numerical grade			
Duratio	n	Module level	Other prerequisites		
1 semester		undergraduate	By way of exception, additional prerequisites are listed in the section on assessments.		

During this practical course, students will acquire an insight into a variety of topics in biotechnology.

### Intended learning outcomes

Students are able to apply advanced methods in biotechnology.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- o7-4BFMZ5N-1-102: P (no information on SWS (weekly contact hours) and course language available)
- o7-4BFMZ5N-2-102: S (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

**Assessment in module component 07-4BFMZ5N-1-102:** Biotechnology 1 Laboratory Practice for Nanostructure Technology

- 4 ECTS, Method of grading: numerical grade
- placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 to 20 pages)
- Assessment offered: once a year, summer semester
- Other prerequisites: Admission prerequisite to assessment: regular attendance of placement.

Assessment in module component o7-4BFMZ5N-2-102: Biotechnology 1 Seminar für Nanostructure Technology

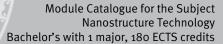
- 1 ECTS, Method of grading: (not) successfully completed
- presentation/seminar presentation (approx. 20 to 30 minutes)
- Assessment offered: once a year, summer semester

### Allocation of places

Number of places: 2. Should the number of applications exceed the number of available places, places will be allocated by lot. 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 a standardised procedure. When places are allocated by lot, 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 reallocated as they become available.

Additional information
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### Workload





### Teaching cycle -Referred to in LPO I (examination regulations for teaching-degree programmes) -Module appears in Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)



Module ti	Module title Abbreviation					
Membran	ne Biology for advanced s	tudents for Nanostruct	ure Technology	07-4BFPS2N-102-m01		
Module c	oordinator		Module offered by			
holder of	the Chair of Plant Physiol	ogy and Biophysics	Faculty of Biology			
ECTS N	Method of grading	Only after succ. c	Only after succ. compl. of module(s)			
5 n	umerical grade					
Duration Module level Other prerequ		Other prerequisit	uisites			
			dmission prerequisite to assessment: regular attendance of exercises s well as successful completion of the respective exercises.			
Contents		,				
In this module, students will acquire the general fundamentals of plant membrane transport and the biophysical methods with which it can be characterised. For this purpose, students will be introduced to modern methods of molecular biology and imaging as well as data collection and analysis.						

### **Intended learning outcomes**

Students understand basic membrane transport processes and are able to use experimental methods in experiments with intact plants, isolated plant cells as well as animal expression systems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 minutes) or b) log (approx. 10 to 20 pages) or c) oral examination of one candidate each (approx. 30 minutes) or d) oral examination in groups of up to 3 candidates (approx. 60 minutes) or e) presentation (approx. 20 to 30 minutes)

### Allocation of places

Number of places: 2. Should the number of applications exceed the number of available places, places will be allocated by lot. 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 a standardised procedure. When places are allocated by lot, 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 reallocated as they become available.

# allocated as they become available. Additional information - Workload - Teaching cycle - Referred to in LPO I (examination regulations for teaching-degree programmes) --

### Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)



Module title					Abbreviation
Methods in Biotechnology for Nanostructure Technology					07-4S1MZ4N-102-m01
Module coordinator				Module offered by	
holder	holder of the Chair of Biotechnology			Faculty of Biology	
ECTS	Meth	Method of grading Only after succ. co		mpl. of module(s)	
5	nume	numerical grade			
Duration Module level		Other prerequisite	s		
1 semester undergraduate		undergraduate			
Containte					

This module will provide students with an overview of instrument-based methods in biotechnology and biomedicine. In particular, imaging methods as well as single-cell technologies will be discussed. Publications on the methodology of biotechnology will be analysed.

### **Intended learning outcomes**

Students are able to select the instrument-based method in biotechnology and biomedicine that is appropriate to a particular problem.

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

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- o7-4S1MZ4N-1-102: V (no information on SWS (weekly contact hours) and course language available)
- o7-4S1MZ4N-2-102: S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component o7-4S1MZ4N-1-102: Methods in Biotechnology for Nanostructure Technology

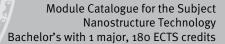
- 3 ECTS, Method of grading: numerical grade
- written examination (approx. 20 minutes)

**Assessment in module component 07-4S1MZ4N-2-102:** Seminar Methods in Biotechnology for Nanostructure Technology

- 2 ECTS, Method of grading: (not) successfully completed
- presentation/seminar presentation (approx. 15 to 20 minutes)
- Assessment offered: once a year, summer semester

### Allocation of places

Number of places: 2. Should the number of applications exceed the number of available places, places will be allocated by lot. 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 a standardised procedure. When places are allocated by lot, 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 reallocated as they become available.





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

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Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2010)



Module title					Abbreviation	
Molecular Biotechnology for Nanostructure Technology					07-4S1MZ5N-102-m01	
Modul	e coord	inator		Module offered by		
holder	holder of the Chair of Biotechnology			Faculty of Biology		
ECTS	Meth	Method of grading Only after succ. co		npl. of module(s)		
5	nume	numerical grade				
Duration Module level		Other prerequisites				
1 seme	1 semester undergraduate					
_						

Theoretical aspects of modern molecular biotechnology.

### **Intended learning outcomes**

Students have acquired knowledge and skills in the area of molecular biotechnology.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$ 

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- o7-4S1MZ5N-1-102: V (no information on SWS (weekly contact hours) and course language available)
- o7-4S1MZ5N-2-102: S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

**Assessment in module component 07-4S1MZ5N-1-102:** Aspects of Modern Biotechnology for Nanostructure Technology

- 3 ECTS, Method of grading: numerical grade
- written examination (approx. 30 minutes)

**Assessment in module component 07-4S1MZ5N-2-102:** Seminar Modern Biotechnology for Nanostructure Technology

- 2 ECTS, Method of grading: (not) successfully completed
- presentation/seminar presentation (approx. 15 to 20 minutes)
- Assessment offered: once a year, summer semester

### Allocation of places

Number of places: 2. Should the number of applications exceed the number of available places, places will be allocated by lot. 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 a standardised procedure. When places are allocated by lot, 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 reallocated as they become available.

## Additional information -Workload -Teaching cycle -Referred to in LPO I (examination regulations for teaching-degree programmes) --



#### Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)



		Abbreviation		
Basics in Bio	technology			07-BTNST-102-m01
Module coor	dinator		Module offered by	
holder of the	Chair of Biotechnolog	gy	Faculty of Biology	
ECTS Meth	nod of grading	Only after succ. con	npl. of module(s)	
2 num	erical grade			
Duration	Module level	Other prerequisites	i .	
2 numerical grade		ns), written examinate questions. If the senoice questions, stume. A minimum of two swers in accordance in and examination is are to be considered multiple choice questions and the number of candidate is no mostions answered contion for the first time from the examination of the questions as the examination of the questions as the examination, the tof the questions as the examination, the required for successives the examination, the required for successives as the examination, the required for successives the examination of the examination, the required for successives the examination of the ex	ations can consist entirely or part elected method of assessment dents will have to be informed to examiners will compile the set e with Section 16 Subsection 1 AS regulations). They will also detered correct. The part of the examisations will be considered suchimum of 60% of the questions minimum of 50% of questions of questions answered correctione than 15% lower than the avergetly by students that took the examination candidates that number of questions required for on as specified in sentence 5 will ion consisting of multiple choice of if they have correctly answered if they have correctly answered he grade befriedigend (satisfactor imum of 25% but less than 50% by have correctly answered less sked. When students are informed enumber of correctly answered sful completion of the examination up mentioned under b) must be	

Students have become familiar with the fundamental principles of biotechnology.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$ 

V + S (no information on SWS (weekly contact hours) and course language available)

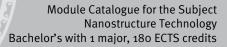
**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 30 minutes)

### **Allocation of places**

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Bachelor's with 1 major Nanostructure Technology	JMU Würzburg • generated 26-Aug-2024 • exam. reg. da-	page 110 / 187
(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	





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



Module	e title		Abbreviation			
Specia	Special Bioinformatics 1				07-4S1MZ6-102-m01	
Module coordinator				Module offered by		
holder of the Chair of Bioinformatics				Faculty of Biology		
ECTS	Meth	Nethod of grading Only after succ		compl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites	rerequisites		
1 seme	mester undergraduate Admission prerequisite to assessment: regular attendance of example and successful completion of the respective exercises as specific beginning of the course.					

#### Contents

Fundamental principles of the tree of life, fundamental principles of phylogenetics (methods and markers), fundamental principles of evolutionary biology (concepts), sequence analysis, RNA structure prediction, phylogenetic reconstruction.

#### Intended learning outcomes

Students are able to use software and databases for sequence analysis, RNA structure prediction and phylogenetic reconstruction.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

log (approx. 10 to 20 pages)

Language of assessment: German or English

#### Allocation of places

Number of places: 20. Should the number of applications exceed the number of available places, places will be allocated as follows: Places will primarily be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits. 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 participant 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 a standardised 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, pla-



ces 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): allocation by lot. 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

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#### Teaching cycle

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### $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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#### Module appears in

Bachelor' degree (1 major) Biology (2011)

Bachelor' degree (1 major) Biology (2010)

Bachelor' degree (1 major) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)

Bachelor's degree (1 major, 1 minor) Biology (Minor, 2010)



Module title					Abbreviation	
Basics in Light- and Electron-Microscopy					07-4S1MZ1-102-m01	
Module coordinator Module offered			Module offered by	1		
head of the Department of Electronmicroscopy			microscopy	Faculty of Biology	Faculty of Biology	
ECTS	Meth	od of grading	Only after succ. c	mpl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisit	es		
1 semester undergraduate Admission prerequisite to assessment: reand successful completion of the respect beginning of the course.						

#### Contents

Fundamental principles of confocal laser scanning microscopy and electron microscopy.

#### Intended learning outcomes

Students have acquired theoretical knowledge and practical skills in the area of light and electron microscopy.

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

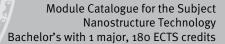
V + Ü (no information on SWS (weekly contact hours) and course language available)

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \ (\textbf{type}, \textbf{scope}, \textbf{language}) \ (\textbf{type}, \textbf{language}) \$ module is creditable for bonus)

written examination (approx. 30 to 60 minutes)

#### Allocation of places

Number of places: 18. Should the number of applications exceed the number of available places, places will be allocated as follows: Places will primarily be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits. 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 participant 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 a standardised 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): allocation by lot. 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

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#### 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 (2011)

Bachelor' degree (1 major) Biology (2010)

Bachelor' degree (1 major) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)

Bachelor's degree (1 major, 1 minor) Biology (Minor, 2010)



Module	e title		Abbreviation		
Specific Biotechnology 2					07-5S2MZ4-102-m01
Module coordinator Mod			Module offered by	l	
holder of the Chair of Biotechnology and Biophysics			and Biophysics	Faculty of Biology	
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisite	S	
1 semester undergraduate Admission prerequisite to assessment: regular attendance of and seminar as well as successful completion of the respective as specified at the beginning of the course.		oletion of the respective exercises			

#### **Contents**

This practical course provides students with an insight into different biotechnological and biophysical topics. Under expert guidance, students will perform selected experiments on the following topics: cellular and molecular biotechnology, nano and microsystems biotechnology, biomaterials and biosensors, high-resolution fluorescence microscopy, fluorescence spectroscopy, analysis and electromanipulation of cells.

#### **Intended learning outcomes**

Students will have acquired a knowledge of fundamental biotechnological and biophysical methods and their applications that will enable them to independently review relevant literature. In addition, they will have become acquainted with - or, where necessary, will be able to independently acquaint themselves with - biophysical mechanisms. Students will have acquired practical experience performing experiments, using a variety of scientific tools. In the seminar, students will have acquired detailed theoretical knowledge on these experiments and will have delivered a short presentation (15 minutes) on one of the experiments they performed.

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

Ü + S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

methods of assessment: a) written examination (approx. 45 to 60 minutes) or b) log (approx. 10 to 20 pages) or c) oral examination of one candidate each (approx. 30 minutes) or d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or e) presentation (approx. 20 to 30 minutes); students will be informed about the method and length of the assessment prior to the course

#### Allocation of places

Number of places: 18. Should the number of applications exceed the number of available places, places will be allocated as follows: Places will primarily be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits. 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 participant 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 a standardised 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): allocation by lot. 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

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#### **Teaching cycle**

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#### $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

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#### Module appears in

Bachelor' degree (1 major) Biology (2011)

Bachelor' degree (1 major) Biology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2010)



Modul	e title				Abbreviation
Bioche	emistry				08-BC-092-m01
Modul	e coord	inator		Module offered by	
holder	of the	Chair of Biochemistry		Chair of Biochemis	try
ECTS	Meth	od of grading	Only after succ. con	ıpl. of module(s)	
6	nume	rical grade			
Durati	on	Module level	Other prerequisites		
2 seme	ester	undergraduate	ses in the respective (usually 70% of exe	e classes as specifie cises to be success	successful completion of exerci- ed at the beginning of the course fully completed) as well as regu- aximum of 2 incidents of unexcu-
Conter	nts				
Compr mistry.	_	ctures and exercises, this	s module acquaints s	tudents with the fun	ndamental principles of bioche-
Intend	led lear	ning outcomes			
		e become familiar with th		ples of biochemistry	. They are able to describe the
Course	<b>es</b> (type, i	number of weekly contact hours,	language — if other than Ger	man)	
V + Ü +	+ V + Ü (	no information on SWS (	weekly contact hours	and course langua	ge available)
		<b>sessment</b> (type, scope, langua	ge — if other than German, o	examination offered — if no	ot every semester, information on whether
or 90 r	ninutes		tions: approx. 60 mir	utes each) or b) ora	tten examinations: approx. 60 l examination of one candidate 30 minutes)
Alloca	tion of	olaces			
Additio	onal inf	ormation			
Workle	oad				
Teachi	ing cycl	e	_		
	<u> </u>		-		
Referred to in LPO I (examination regulations for teaching-degree programmes)					
				55)	
Modul	e anne	ars in			
Module appears in  Bachelor' degree (1 major) Chemistry (2010)  Bachelor' degree (1 major) Chemistry (2009)  Bachelor' degree (1 major) Nanostructure Technology (2010)  Bachelor' degree (1 major) Nanostructure Technology (2012)					
	_	ree (1 major) FOKUS Cher	•,		
Mantaula da vas ( vasia) Chamistau (a a a)					

Master's degree (1 major) Chemistry (2010)



Module	Module title Abbreviation				
Bioche	mistry	(teaching degree for sec	ondary schools)		08-BC-LAGY-092-m01
Module	e coord	inator		Module offered by	
		Chair of Biochemistry		Chair of Biochemist	try
ECTS	Metho	od of grading	Only after succ. com	ipl. of module(s)	,
3	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate	ses in the respective (usually 70% of exe	e classes as specifie rcises to be success	successful completion of exercidat the beginning of the course fully completed) as well as reguaximum of 2 incidents of unexcu-
Conten	ts		•		
Compri mistry.	ising le	ctures and exercises, this	s module acquaints s	tudents with the fun	damental principles of bioche-
Intende	ed learı	ning outcomes			
		e become familiar with th		ples of biochemistry	. They are able to describe the
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
V + Ü (r	no infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether
or 90 m each (a	ninutes approx.		tions: approx. 60 min	utes each) or b) ora	tten examinations: approx. 60 l examination of one candidate . 30 minutes)
Allocat					
Additio	nal inf	ormation			
Worklo	ad				
Teachi	ng cycl	e			
<u></u>					
		LPO I (examination regulation		mmes)	
§ 62 (1) 2. Chemie "Organische und Bioorganische Chemie"					
Module					
	_	ree (1 major) Physics (20			
	_	ree (1 major) Nanostructı ree (1 major) Nanostructı			
	_	mination for the teaching			



Module	Module title Abbreviation					
Current	t Topic	s in Nanostructure Techn	ology		11-BXN5-112-m01	
Module coordinator				Module offered by	<u> </u>	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade	-			
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	its					
Current or stud	•	•	. Accredited academi	c achievements, e.g.	. in case of change of university	
Intend	ed lear	ning outcomes				
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know- cation areas.	
		mation on SWS (weekly o			able)	
module is	s creditab en exa	ole for bonus) mination (approx. 120 mi	nutes) or b) oral exar	nination of one cand	lidate each or oral examination on pages, time to complete: 1 to 4	
weeks)	or d) p	resentation/seminar pre ssessment: German, Eng	sentation (approx. 30		o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	ars in				
	_	ree (1 major) Nanostructu				
Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module	Module title Abbreviation					
Current	t Topics	s in Nanostructure Techn	ology		11-BXN6-112-m01	
Module	e coord	inator		Module offered by	l .	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university	
Intend	ed lear	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this knowication areas.	
		mation on SWS (weekly o			able)	
		<b>Gessment</b> (type, scope, langua le for bonus)	ge — if other than German, (	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	ars in				
	_	ree (1 major) Nanostructu				
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)					



Module	Module title Abbreviation					
Current	t Topics	s in Nanostructure Techn	ology		11-BXN8-112-mo1	
Module coordinator				Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed lear	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know-cation areas.	
		mation on SWS (weekly contact nours, t			abla)	
a) writti in grou weeks)	en exar ps (app or d) p	le for bonus) mination (approx. 120 mi	nutes) or b) oral exar didate) or c) project ro sentation (approx. 30	nination of one cand eport (approx. 8 to 10	lidate each or oral examination on whether or oral examination opages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation	•			
Worklo	ad					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	rs in				
	_	ree (1 major) Nanostructu				
Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module title Abbreviation					
Topics	in Physics			11-BXP5-112-m01	
coordi	inator		Module offered by		
son of	examination committee	1	Faculty of Physics a	and Astronomy	
Metho	d of grading	Only after succ. con	pl. of module(s)		
numer	ical grade				
1	Module level	Other prerequisites			
ter	undergraduate	Approval by examin	ation committee req	uired.	
s					
		eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
d learr	ing outcomes				
cal Ph ipline Ige. Th	ysics of the Bachelor's p of Physics and understa ey are able to classify th	rogramme of Nanosti nd the measuring and le subject-specific co	ructure Technology.  I/or calculation method intexts and know the	They have knowledge of a current hods necessary to acquire this	
(type, n	umber of weekly contact hours,	language — if other than Ger	man)		
infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		nge — if other than German, o	examination offered — if no	ot every semester, information on whether	
s (app or d) p	rox. 30 minutes per can resentation/seminar pre	didate) or c) project resentation (approx. 30	eport (approx. 8 to 10		
on of p	laces				
al info	ormation				
d					
Teaching cycle					
l to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
appea	rs in				
	coording son of Method numer so son of universe so funive dents he cal Pheno informof assereditable nexares (apport d) per of asserted table nexares (apport d) per	coordinator son of examination committee Method of grading numerical grade Module level ter undergraduate scopics of Experimental and Theof university or study abroad. Id learning outcomes lents have advanced competer cal Physics of the Bachelor's pline of Physics and understate. They are able to classify the (type, number of weekly contact hours, or information on SWS (weekly of assessment (type, scope, languate and preditable for bonus) In examination (approx. 120 minus (approx. 30 minutes per cannot d) presentation/seminar preditable for bonus. In examination (approx. 120 minus (approx. 30 minutes per cannot d) presentation/seminar preditable for bonus. In examination (approx. 120 minus (approx. 120 minu	Topics in Physics  coordinator  son of examination committee  Method of grading numerical grade  in Module level ter undergraduate  Approval by examin  stopics of Experimental and Theoretical Physics. According university or study abroad.  Id learning outcomes  lents have advanced competencies corresponding to cal Physics of the Bachelor's programme of Nanostropline of Physics and understand the measuring and ge. They are able to classify the subject-specific contitype, number of weekly contact hours, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment (type, scope, language—if other than German, or of assessment: German or English  on of places  lat information  d  to in LPO I (examination regulations for teaching-degree programation LPO I (examination regulations for teaching-degree programatical progra	Topics in Physics  coordinator  son of examination committee  Method of grading  numerical grade  Module level  In Module level  Other prerequisites  ter undergraduate  Approval by examination committee requirents of university or study abroad.  It learning outcomes  lents have advanced competencies corresponding to the requirements and Physics of the Bachelor's programme of Nanostructure Technology. pline of Physics and understand the measuring and/or calculation metige. They are able to classify the subject-specific contexts and know the (type, number of weekly contact hours, language — if other than German)  Information on SWS (weekly contact hours) and course language avail of assessment (type, scope, language — if other than German, examination offered — if no reditable for bonus)  In examination (approx. 120 minutes) or b) oral examination of one cance of assessment: German or English  In of places  In LPO 1 (examination regulations for teaching-degree programmes)	



Module	title	,			Abbreviation		
Current	Topics	s in Physics			11-BXP6-112-m01		
Module	coord	inator		Module offered by			
chairperson of examination committee			?	Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
6	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.		
Contents							
		of Experimental and Theversity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of		
Intende	ed learı	ning outcomes					
Theores subdis- knowle	tical Ph cipline dge. Th	ysics of the Bachelor's p of Physics and understa ney are able to classify th	rogramme of Nanosti nd the measuring and le subject-specific co	ructure Technology.  I/or calculation metl  ntexts and know the	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.		
Course	<b>S</b> (type, n	umber of weekly contact hours,	language — if other than Ger	man)			
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)		
		sessment (type, scope, langua le for bonus)	nge — if other than German, o	examination offered — if no	ot every semester, information on whether		
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4		
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
Teachi	Teaching cycle						
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)			
Module	appea	rs in					
	• • • • • • • • • • • • • • • • • • • •						



Module	Module title Abbreviation					
Current	t Topics	s in Physics			11-BXP8-112-m01	
Module	coord	inator		Module offered by		
chairperson of examination committee			!	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Contents						
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theore:	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology. I/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	number of weekly contact hours,	language — if other than Ger	rman)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
<del></del>						
Teachi	Teaching cycle					
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	e appea	rs in				



# **Experimental Physics**

(ECTS credits)

Abbreviation



Module title

Module	: title				Appleviation	
Physics	s of Co	mplex Systems			11-PKS-092-m01	
Module	coord	inator		Module offered by		
Managing Director of the Institute of Theoretical Phy and Astrophysics			heoretical Physics	Physics Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semester graduate		graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.			

#### **Contents**

- 1. Theory of critical phenomena in thermal equilibriumt
- 2. Introduction into the physics out of equilibriumt
- 3. Entropy production and fluctuationst
- 4. Phase transitions away from equilibriumt
- 5. Universalityt
- 6. Spin glassest
- 7. Theory of neural networks

#### **Intended learning outcomes**

The students have specific and advanced knowledge in the field of physics of complex systems. They know the methods of Statistical Physics, Computational Physics and non-linear dynamics, which are used to describe such systems. They are able to work on current research problems in this area.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### Allocation of places

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#### **Additional information**

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#### Workload

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#### **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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

Master's degree (1 major) Mathematical Physics (2012)

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

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

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



Module title					Abbreviation	
Metho	ds in Sı	urface Spectroscopy			11-MSS-102-m01	
Module coordinator				Module offered by		
Manag	ing Dire	ector of the Institute o	of Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
4	nume	rical grade				
Duratio	on	Module level	Other prerequisites	Other prerequisites		
		graduate	sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	trer will inform studer the course. Registration on of will to seek admed the qualification fo mester, the lecturer value in t. Students who mee on the current or in the date, students will ha	alify for admission to as- ints about the respective details ion for the course will be con- ission to assessment. If stu- r admission to assessment over will put their registration for as- t all prerequisites will be admit- e subsequent semester. For as- ave to obtain the qualification fo	
Conten	ts					
Boundary conditions of experiments: Ultra-high vacuum, surface sensibility, light-matter-interaction, principles of photoelectron spectroscopy (PES), one-particle image of PES, three step model, many-particle effects, line shape, satellites, Fermi liquid, quasiparticles, exemplary systems and spectra, measurements with synchrotron						

#### **Intended learning outcomes**

radiation, related experimental methods.

The students know the physical principles and experimental methods of surface spectroscopy. They are able to conduct, evaluate and interpret simple measurements.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### Allocation of places

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#### Additional information

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#### Workload

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#### **Teaching cycle**

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

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



#### Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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



Module	e title			Abbreviation		
Solid S	tate S <sub>l</sub>	pectroscopy		11-FKS-092-m01		
Module coordinator				Module offered by		
Manag	ing Dir	ector of the Institute	of Applied Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. c	ompl. of module(s)		
6	nume	erical grade				
Duratio	n	Module level	Other prerequisit	Other prerequisites		
<b>Duration</b> 1 semester		graduate	sessment. The led at the beginning of sidered a declarated dents have obtain the course of the sessment into efforted to assessmen	ites must be met to qualify for admission to asturer will inform students about the respective details of the course. Registration for the course will be contion of will to seek admission to assessment. If stuned the qualification for admission to assessment over semester, the lecturer will put their registration for astect. Students who meet all prerequisites will be admitted in the current or in the subsequent semester. For aster date, students will have to obtain the qualification for essment anew.		

Single- and many-particle picture of electrons in solids. Light-matter interaction. Optical spectroscopy. Electron spectroscopy. X-ray spectroscopies.

#### **Intended learning outcomes**

The students have specific and advanced knowledge in the field of solid-state spectroscopy. They know different types of spectroscopy and their fields of application. They understand the theoretical principles and the current developments in research.

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

R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

# Allocation of places

## Additional information

#### **Teaching cycle**

Workload

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

#### Module appears in



Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)



Module title	e		Abbreviation		
Semicondu	ctor Physics		11-HLP-092-m01		
Module cod	rdinator		Module offered by		
Managing Director of the Institute of Applied Physics			Faculty of Physics and Astronomy		
ECTS Me	thod of grading	Only after succ. co	mpl. of module(s)		
6 nur	nerical grade				
Duration	Module level	Other prerequisite	Other prerequisites		
1 semester graduate		sessment. The lect at the beginning of sidered a declarat dents have obtain	tes must be met to qualify for admission to asturer will inform students about the respective details if the course. Registration for the course will be contion of will to seek admission to assessment. If stued the qualification for admission to assessment over the emester, the lecturer will put their registration for assessment.		

Advanced examination of crystal bonding and the electronic band structure of semiconductors. Optical excitations and their coupling effects. Electron-phonon coupling. Temperature-dependent transport properties. Quantisation effects of semiconductors with reduced dimensions. (Semi-)magnetic semiconductors.

#### **Intended learning outcomes**

The students have specific and advanced knowledge in the field of Semiconductor Physics. They know the physical principles of semiconductors and have gained an overview of the important characteristics of semiconductor materials.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### Allocation of places

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#### Additional information

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#### Workload

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#### Teaching cycle

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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#### Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)

Master's degree (1 major) Functional Materials (2012)



Module	e title				Abbreviation
Magne	tism				11-MAG-092-m01
Module coordinator				Module offered by	
Managi	ing Dire	ector of the Institute of Ap	pplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semester graduate		graduate	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.		

#### Contents

Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain structure, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo effect.

#### **Intended learning outcomes**

The students know basic terms, concepts and phenomena of magnetism and measuring methods for magnetic experiments; they are skilled in simple model building and in the formulation of mathematical-physical approaches and are able to apply them to tasks in the stated areas; they have competencies in independently working on problems of these areas; they are able to evaluate the accuracy of observations and analyses.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### **Allocation of places**

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#### **Additional information**

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#### Workload

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#### 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) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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



Module	Module title Abbreviation						
Curren	t Topic	s in Nanostructure Techn	ology		11-BXN5-112-m01		
Module	e coord	inator		Module offered by			
chairperson of examination committee				Faculty of Physics a	and Astronomy		
ECTS				ipl. of module(s)	,		
5	1	rical grade		•			
Duratio	on	Module level	Other prerequisites				
1 seme	ester	undergraduate	Approval by examin	ation committee req	uired.		
Contents							
	t topics ly abroa		. Accredited academi	c achievements, e.g.	. in case of change of university		
Intend	ed lear	ning outcomes					
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this know-ication areas.		
	_	rmation on SWS (weekly o			able)		
		<b>sessment</b> (type, scope, langua ble for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether		
in grou weeks)	ıps (apı ) or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4		
	tion of <sub>I</sub>	-					
Additio	onal inf	ormation					
Worklo	oad						
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	e appea	ars in					
	_	ree (1 major) Nanostructu	•,				
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module	Module title Abbreviation						
Current	t Topic	s in Nanostructure Techn	ology		11-BXN6-112-m01		
Module	e coord	inator		Module offered by			
chairperson of examination committee				Faculty of Physics a	and Astronomy		
ECTS   Method of grading   Only after succ. compl. of module(s)			•				
6	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.		
Contents							
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university		
Intend	ed lear	ning outcomes					
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	odiscipline of nanostructure techs s necessary to acquire this know- ication areas.		
		mation on SWS (weekly o			able)		
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, (	examination offered — if no	ot every semester, information on whether		
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4		
Allocat		_					
Additio	onal inf	ormation					
Worklo	ad						
Teachi	ng cycl	e					
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	e appea	ars in					
	_	ree (1 major) Nanostructu	•, .				
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module title Abbreviation					Abbreviation	
Current Topics in Nanostructure Technology					11-BXN8-112-m01	
Module coordinator				Module offered by		
chairperson of examination committee				Faculty of Physics and Astronomy		
ECTS		od of grading	Only after succ. con			
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
			Approval by examin	ation committee req	uired.	
Conten	nts					
	t topics ly abroa		. Accredited academi	c achievements, e.g.	. in case of change of university	
Intend	ed lear	ning outcomes				
Technology of the Bachelor's programme. They have knowledge of a current subdiscipline of nanostructure technology or nano sciences and understand the measuring and evaluation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.  Courses (type, number of weekly contact hours, language — if other than German)						
	_	mation on SWS (weekly o			able)	
module is	s creditab	le for bonus)			ot every semester, information on whether	
in grou weeks)	ıps (app ) or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	o pages, time to complete: 1 to 4	
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Worklo	oad					
<del></del>						
Teaching cycle						
<del></del>						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	ars in				
Bachelor' degree (1 major) Nanostructure Technology (2010)						
Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module title Abbreviation					Abbreviation	
Current Topics in Physics					11-BXP5-112-m01	
Module coordinator				Module offered by		
chairpe	rson o	f examination committee	<u> </u>	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	•		
5	nume	rical grade				
		Other prerequisites				
1 semester undergraduate		Approval by examination committee required.				
Conten	ts					
	Current topics of Experimental and Theoretical Physics. Accredited academic achievements, e.g. in case of change of university or study abroad.				hievements, e.g. in case of	
Intende	ed lear	ning outcomes				
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Bachelor's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.						
Course	<b>S</b> (type, r	number of weekly contact hours,	anguage — if other than Ger	rman)		
V + R (n	V + R (no information on SWS (weekly contact hours) and course language available)					
	<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)					
a) written examination (approx. 120 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Language of assessment: German or English						
Allocat	ion of p	olaces				
Additional information						
Workload						
<del></del>						
Teaching cycle						
<u></u>						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
<del></del>						
Module	Module appears in					



Module title Abbreviation				
		11-BXP6-112-m01		
	Module offered by			
	Faculty of Physics and Astronomy			
Only after succ. con	cc. compl. of module(s)			
numerical grade				
Other prerequisites	es			
Approval by examination committee required.				
oretical Physics. Acc	redited academic ac	hievements, e.g. in case of		
The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Bachelor's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.				
anguage — if other than Ger	rman)			
V + R (no information on SWS (weekly contact hours) and course language available)				
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)				
a) written examination (approx. 120 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Language of assessment: German or English				
Allocation of places				
Additional information				
Workload				
Teaching cycle				
Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module appears in				
	Other prerequisites Approval by examin oretical Physics. Accordices corresponding to rogramme of Nanostrand the measuring and esubject-specific cordinates and the measuring and esubject-specific cordinates and cordinates are if other than German, or the sentation (approx. 30 anglish	Faculty of Physics at Only after succ. compl. of module(s)  Other prerequisites  Approval by examination committee requirements of coretical Physics. Accredited academic actions corresponding to the requirements of rogramme of Nanostructure Technology. In the measuring and/or calculation mether subject-specific contexts and know the anguage — if other than German)  Sontact hours) and course language availage — if other than German, examination offered — if not nutes) or b) oral examination of one cancellidate) or c) project report (approx. 8 to 10 sentation (approx. 30 minutes) anglish		



Module	Module title Abbreviation					
Current Topics in Physics					11-BXP8-112-m01	
Module	Module coordinator			Module offered by		
chairpe	rson o	f examination committee	?	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	mpl. of module(s)		
8	nume	rical grade				
Duration Module level O		Other prerequisites				
1 seme	1 semester undergraduate		Approval by examination committee required.			
Conten	Contents					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theoret subdisc	The students have advanced competencies corresponding to the requirements of a module of Experimental or Theoretical Physics of the Bachelor's programme of Nanostructure Technology. They have knowledge of a current subdiscipline of Physics and understand the measuring and/or calculation methods necessary to acquire this knowledge. They are able to classify the subject-specific contexts and know the application areas.					
Course	Courses (type, number of weekly contact hours, language — if other than German)					
V + R (n	V + R (no information on SWS (weekly contact hours) and course language available)					
	<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)					
a) written examination (approx. 120 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Language of assessment: German or English						
Allocat	Allocation of places					
Additional information						
Workload						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	Module appears in					



# **Theoretical Physics**

(ECTS credits)



Module title				Abbreviation		
Theoretical Mechanics				11-TM-092-m01		
Module	coord	inator		Module offered by		
Managing Director of the Institute of Th and Astrophysics			Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	ECTS Method of grading		Only after succ. con	Only after succ. compl. of module(s)		
8	nume	rical grade				
Duration Module level		Other prerequisites				
1 semester		undergraduate	sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	es must be met to qualify for admission to as- urer will inform students about the respective details the course. Registration for the course will be con- on of will to seek admission to assessment. If stu- d the qualification for admission to assessment over emester, the lecturer will put their registration for as- ct. Students who meet all prerequisites will be admit- in the current or in the subsequent semester. For as- date, students will have to obtain the qualification for sment anew.		

#### Contents

Newtonian mechanics, Lagrangian and Hamiltonian formalism, conservation laws, limits of classical physics.

#### **Intended learning outcomes**

The students have knowledge of the principles of classical theoretical mechanics and the required calculation methods.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of fered} - \textbf{if not every semester, information on whether} \ \\$ module is creditable for bonus)

written examination (approx. 120 minutes, for modules with less than 4 ECTS credits approx. 90 minutes; unless otherwise specified)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

#### Allocation of places

#### **Additional information**

#### Workload

#### **Teaching cycle**

#### $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

#### Module appears in

Bachelor' degree (1 major) Mathematics (2012)

Bachelor' degree (1 major) Mathematics (2013)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Computational Mathematics (2012)



Bachelor' degree (1 major) Computational Mathematics (2013) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



Module title Abbreviation						
Theoretical Electrodynamics					11-ED-092-m01	
Module coordinator				Module offered by		
Managi and As			of Theoretical Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 semester undergraduate		sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for			
Conten	ts					
		lectrostatics, magne	tostatics, Maxwell equat	ions, covariant form	ulation, electrodynamics and	
Intende	ed learı	ning outcomes				
The stu	idents l	nave knowledge of th	e principles of classical	electrodynamics and	the required calculation me-	
Course	<b>S</b> (type, n	umber of weekly contact ho	ours, language — if other than Ge	rman)		
V + Ü (r	no infor	mation on SWS (wee	kly contact hours) and co	ourse language avail	lable)	
		<b>sessment</b> (type, scope, la le for bonus)	anguage — if other than German,	examination offered — if no	ot every semester, information on whether	
otherw Assess and wil	ise spe ment o Il be an	cified) ffered: When and ho	w often assessment will	be offered depends	edits approx. 90 minutes; unless on the method of assessment 3 ASPO (general academic and	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teachi	ng cycl	е				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	rs in				
Bachel	Bachelor' degree (1 major) Mathematics (2012)					

Bachelor' degree (1 major) Mathematics (2013)



Bachelor' degree (1 major) Computational Mathematics (2012) Bachelor' degree (1 major) Computational Mathematics (2013) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



Module title					Abbreviation	
Quantum Mechanics II					11-QM2-092-m01	
Module	coord	inator		Module offered by		
Managi and As	_	ector of the Institute of sics	Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites	Other prerequisites		
1 semester undergraduate		sessment. The lectuat the beginning of sidered a declaration dents have obtaine the course of the sessment into effected to assessment i	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment annow.			

#### **Contents**

"Quantum mechanics II" constitutes the central theoretical course of the international Master's program in Physics. It builds upon basics which are acquired in the lecture "Quantum mechanics I" of the Bachelor's degree. While the specific emphasis can be adjusted individually, the core topics that are supposed to be covered should include:

- 1. Second quantisation: Fermions and bosons
- 2. Band structures of particles in a crystal
- 3. Angular momentum, symmetry operators, Lie Algebras
- 4. Scattering theory: Potential scattering, partial wave expansion
- 5. Relativistic quantum mechanics: Klein-Gordon equation, Dirac equation, Loretz group, fine structure splitting of atomic spectra
- 6. Quantum entanglement
- 7. Canonical formalism

# **Intended learning outcomes**

The students acquire in-depth knowledge of advanced quantum mechanics and have a thorough understanding of the mathematical and theoretical concepts of the listed topics. They are able to describe or model problems of modern theoretical Quantum Physics mathematically, to solve problems analytically, to use approximation methods and to interpret the results physically. The course is pivotal to subsequent theory courses in Astrophysics, High-Energy Physics and Condensed Matter/Solid-State Physics. The course is mandatory for all Master's students.

 $\textbf{Courses} \ (\textbf{type, number of weekly contact hours, language} - \textbf{if other than German})$ 

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English



Allocation of places

-

**Additional information** 

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Workload

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Teaching cycle

--

 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-} \underline{\text{degree programmes}})$ 

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# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

Master's degree (1 major) Mathematical Physics (2012)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)



Module title Abbreviation							
Current Topics in Nanostructure Technology 11-BXN5-112-mo1					11-BXN5-112-m01		
Module coordinator				Module offered by	J.		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	ipl. of module(s)			
5	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.		
Conten	ıts						
	t topics ly abroa	•	. Accredited academi	c achievements, e.g.	. in case of change of university		
Intend	ed learı	ning outcomes					
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know-cation areas.		
V + R (r	no infor	mation on SWS (weekly o	contact hours) and co	urse language avail	able)		
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether		
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4		
Allocat	tion of p	olaces					
	-						
Additio	onal inf	ormation					
Worklo	ad						
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	e appea	ars in					
	Bachelor' degree (1 major) Nanostructure Technology (2010)						
Bachelor' degree (1 major) Nanostructure Technology (2012)							



Module title Abbreviation							
Current	t Topics	s in Nanostructure Techn	ology		11-BXN6-112-m01		
Module coordinator				Module offered by	l.		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
6	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.		
Conten	ts						
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university		
Intend	ed lear	ning outcomes					
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this knowication areas.		
		mation on SWS (weekly o			able)		
		<b>Gessment</b> (type, scope, langua le for bonus)	ge — if other than German, (	examination offered — if no	ot every semester, information on whether		
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4		
Allocat							
Additio	nal inf	ormation					
Worklo	ad						
Teaching cycle							
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	e appea	ars in					
	Bachelor' degree (1 major) Nanostructure Technology (2010)						
Bachelor' degree (1 major) Nanostructure Technology (2012)							



Module title Abbreviation						
Current Topics in Nanostructure Technology 11-BXN8					11-BXN8-112-mo1	
Module coordinator				Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed lear	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know-cation areas.	
		mation on SWS (weekly contact nours, t			abla)	
a) writti in grou weeks)	en exar ps (app or d) p	le for bonus) mination (approx. 120 mi	nutes) or b) oral exar didate) or c) project ro sentation (approx. 30	nination of one cand eport (approx. 8 to 10	lidate each or oral examination on whether or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation	•			
Worklo	ad					
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appea	rs in				
	Bachelor' degree (1 major) Nanostructure Technology (2010)					
Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module	Module title Abbreviation					
Current Topics in Physics 11-BX				11-BXP5-112-m01		
Module	coord	inator		Module offered by		
chairpe	rson o	f examination committee	<u> </u>	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con		,	
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed lear	ning outcomes				
Theoret subdise	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology. d/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, r	number of weekly contact hours,	anguage — if other than Ger	rman)		
V + R (n	o infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	didate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teaching cycle						
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	Module appears in					



Module	Module title Abbreviation					
Current Topics in Physics 11-BXP6-112-mo1					11-BXP6-112-m01	
Module	coord	inator		Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and Theversity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theores subdis- knowle	tical Ph cipline dge. Th	ysics of the Bachelor's p of Physics and understa ney are able to classify th	rogramme of Nanosti nd the measuring and le subject-specific co	ructure Technology.  I/or calculation metl  ntexts and know the	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	umber of weekly contact hours,	language — if other than Ger	man)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	nge — if other than German, o	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teaching cycle						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	Module appears in					



Module	Module title Abbreviation					
Current	Current Topics in Physics 11-BXP8-112-mo1					
Module	coord	inator		Module offered by		
chairpe	erson o	f examination committee	!	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theore:	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology. I/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	number of weekly contact hours,	language — if other than Ger	rman)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teaching cycle						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	rs in				



# **Technical Lab Course and Computer-aided Methods**

(ECTS credits)



Module	title				Abbreviation
Electro	nics				11-A2-092-m01
Module	coord	linator		Module offered by	
Managi	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semester undergraduate		Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.		nts about the respective details ion for the course will be consission to assessment. If sturadmission to assessment over will put their registration for astall prerequisites will be admites subsequent semester. For as-	

Principles of electronic components and circuits. Analogous circuit technology: Passive (resistors, capacitors, coils and diodes) and active components (bipolar and field-effect transistors, operational amplifiers). Digital circuits: different types of gates and CMOS circuits. Microcontroller

# Intended learning outcomes

The students have knowledge of the practical setup of electronic circuits from the field of analogous and digital circuit technology.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

# Allocation of places

Only as part of pool of general key skills (ASQ): 15 places. Places will be allocated by lot.

## **Additional information**

#### Workload

# **Teaching cycle**

# $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

Master's degree (1 major) Physics (2011)

Bachelor's with 1 major Nanostructure Technology	JMU Würzburg • generated 26-Aug-2024 • exam. reg. da-	page 157 / 187
(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



Master's degree (1 major) Nanostructure Technology (2011) Master's degree (1 major) FOKUS Physics (2011) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



WÜ	İRZBL	JRG \	5 (2.3. 2.4) 8	Bache	elor's with 1 major, 180 ECTS credits			
Module	Module title Abbreviation							
Practica	al Cour	rse Physical Technology	of Material Synthesis	5	11-PPT-092-m01			
Module	coord	inator		Module offered by				
Managi	ng Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	and Astronomy			
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)				
5	(not)	successfully completed						
Duratio	n	Module level	Other prerequisites					
1 seme.	Ster .	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective of at the beginning of the course. Registration for the course will be sidered a declaration of will to seek admission to assessment. If sidents have obtained the qualification for admission to assessment the course of the semester, the lecturer will put their registration for sessment into effect. Students who meet all prerequisites will be ted to assessment in the current or in the subsequent semester. For sessment at a later date, students will have to obtain the qualification admission to assessment anew.			ents about the respective details tion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- ne subsequent semester. For as-			
Conten	ts							
Physical material properties, growth and coating procedures, methods of characterisation and structuring technologies.								
Intended learning outcomes								
The students have knowledge of the practical basics of material characterisation and physical technology for material synthesis.								
Courses	<b>5</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)				

P (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Preparing the experiment will be considered successfully completed if an oral test (duration: approx. 15 minutes) prior to the experiment is passed. Performing and evaluating the experiment will be considered successfully completed if a Testat (exam) is passed. An experiment log (approx. 8 pages) is to be prepared. Each component of the assessment can be repeated once in the respective semester. Only if both components of the assessment have been successfully completed in the same semester will the module component be considered successfully completed.

Assessment offered: once a year, winter semester

#### Allocation of places

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# Additional information

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# Workload

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# **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) Nanostructure Technology (2010)



Bachelor' degree (1 major) Functional Materials (2012)

Abbroviotion



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Module title					Abbreviation	
Computational Physics					11-A1-092-m01	
Module	coord	inator		Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics			f Theoretical Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites	Other prerequisites		
1 semester undergraduate		sessment. The lectuat the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment i	trer will inform stude the course. Registrat on of will to seek adn d the qualification fo mester, the lecturer t. Students who mee n the current or in th date, students will h	alify for admission to asents about the respective details ion for the course will be connission to assessment. If stuor admission to assessment over will put their registration for aset all prerequisites will be admite subsequent semester. For asave to obtain the qualification for		

#### **Contents**

- Introduction to programming on the basis of C++ / Java / Mathematica
- numerical solution of differential equations
- simulation of chaotic systems
- generation of random numbers
- random walk
- many-particle processes and reaction diffusion model

## Intended learning outcomes

The students have knowledge of two major programming languages and know algorithms important for Physics. They have knowledge of numerical standard methods and are able to apply computer-assisted processes to the solution of physical problems, e.g. algorithms for solving numerical problems of Physics.

 $\textbf{Courses} \ (\text{type, number of weekly contact hours, language} - \text{if other than German})$ 

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 120 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

## Allocation of places

Only as part of pool of general key skills (ASQ): 15 places. Places will be allocated by lot.

# **Additional information**

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# Workload

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# **Teaching cycle**

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2010)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



Module	e title				Abbreviation	
Labora	tory an	d Measurement Techno	logy		11-A3-072-m01	
Module	Module coordinator			Module offered by		
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	Other prerequisites		
1 semester undergraduate		50% of exercises. Co sion to assessment, ve details at the beg be considered a dec students have obtai over the course of the assessment into eff mitted to assessme	ertain prerequisites in the lecturer will infogrant of the course claration of will to seined the qualification esemester, the lect ect. Students who must in the current or ir date, students will	successful completion of approx. must be met to qualify for admisorm students about the respecti Registration for the course will ek admission to assessment. If a for admission to assessment curer will put their registration for eet all prerequisites will be adathe subsequent semester. For I have to obtain the qualification		

#### **Contents**

Introduction to electronic and optical measuring methods of physical metrology, vacuum technology and cryogenics, cryogenics, light sources, spectroscopic methods and measured value acquisition.

# Intended learning outcomes

The students have acquired the following transferable skills: Electronic and optical measuring methods in physical metrology, cryogenics and vacuum technology, cryogenics, light sources, spectroscopic methods and measured value acquisition.

 $\textbf{Courses} \ (\textbf{type}, \, \textbf{number of weekly contact hours, language} - \textbf{if other than German})$ 

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 120 minutes)

# Allocation of places

Only as part of pool of general key skills (ASQ): 15 places. Places will be allocated by lot.

#### **Additional information**

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# Workload

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# 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) Physics (2007)

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2009)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Physics (2008)



Bachelor' degree (1 major) Nanostructure Technology (2008)

Bachelor' degree (1 major) Nanostructure Technology (2007)

Master's degree (1 major) Technology of Functional Materials (2010)

Master's degree (1 major) Technology of Functional Materials (2009)

Master's degree (1 major) Functional Materials (2012)

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2008)

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



sessment. The lect at the beginning of sidered a declaration dents have obtained the course of the sessment into effect ted to assessment sessment at a late	•				
Dean of Studies Mathematik (Mathematics)  ECTS Method of grading Only after succ. comparison on the present of	Institute of Mathematics  ompl. of module(s)  es  tes must be met to qualify for admission to asturer will inform students about the respective details f the course. Registration for the course will be contion of will to seek admission to assessment. If studente qualification for admission to assessment over the enterty of the lecturer will put their registration for aster. Students who meet all prerequisites will be admitted in the current or in the subsequent semester. For as-				
ECTS Method of grading  10 numerical grade   Duration Module level Other prerequisite  1 semester undergraduate Certain prerequisite sessment. The lect at the beginning or sidered a declarate dents have obtaine the course of the sessment into effet ted to assessment sessment at a late	tes must be met to qualify for admission to asturer will inform students about the respective details f the course. Registration for the course will be conion of will to seek admission to assessment. If stued the qualification for admission to assessment over semester, the lecturer will put their registration for aster. Students who meet all prerequisites will be admitted in the current or in the subsequent semester. For as-				
Duration Module level Other prerequisite  semester undergraduate Certain prerequisite sessment. The lect at the beginning o sidered a declarati dents have obtain the course of the s sessment into effe ted to assessment sessment at a late	tes must be met to qualify for admission to asturer will inform students about the respective details f the course. Registration for the course will be contion of will to seek admission to assessment. If stued the qualification for admission to assessment over the enterty of the lecturer will put their registration for astect. Students who meet all prerequisites will be admitted in the current or in the subsequent semester. For as-				
Duration Module level Other prerequisite  1 semester undergraduate Certain prerequisite sessment. The lect at the beginning or sidered a declarate dents have obtained the course of the sessment into effect ted to assessment sessment at a late	tes must be met to qualify for admission to asturer will inform students about the respective details f the course. Registration for the course will be conion of will to seek admission to assessment. If stued the qualification for admission to assessment over semester, the lecturer will put their registration for astet. Students who meet all prerequisites will be admitten the current or in the subsequent semester. For as-				
1 semester undergraduate Certain prerequisit sessment. The lect at the beginning of sidered a declaration dents have obtain the course of the sessment into effected to assessment sessment at a late	tes must be met to qualify for admission to asturer will inform students about the respective details f the course. Registration for the course will be conion of will to seek admission to assessment. If stued the qualification for admission to assessment over semester, the lecturer will put their registration for astet. Students who meet all prerequisites will be admitten the current or in the subsequent semester. For as-				
sessment. The lect at the beginning of sidered a declaration dents have obtained the course of the sessment into effect ted to assessment sessment at a late	turer will inform students about the respective details if the course. Registration for the course will be conion of will to seek admission to assessment. If stued the qualification for admission to assessment over semester, the lecturer will put their registration for assect. Students who meet all prerequisites will be admitted in the current or in the subsequent semester. For as-				
admission to asse	ssment anew.				
<b>Contents</b> Solution of systems of linear equations and curve fitting p					
ons, interpolation with polynomials, splines and trigonom	etric functions, numerical integration.				
Intended learning outcomes					
The student is acquainted with the fundamental concepts to practical problems and knows about their typical fields					
$\textbf{Courses} \ \text{(type, number of weekly contact hours, language} - \text{if other than G}$	German)				
V + $\ddot{\text{U}}$ (no information on SWS (weekly contact hours) and	course language available)				
<b>Method of assessment</b> (type, scope, language — if other than German module is creditable for bonus)	n, examination offered — if not every semester, information on whether				
written examination (approx. 90 to 180 minutes) if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner					
Allocation of places					

# Workload

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# **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) Nanostructure Technology (2012)

Bachelor' degree (1 major) Economathematics (2012)

Bachelor' degree (1 major) Functional Materials (2012)



Modul	e title				Abbreviation
Progra	mming	course for students of M	lathematics and othe	r subjects	10-M-PRG-122-m01
Modul	e coord	linator		Module offered by	
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Meth	od of grading	Only after succ. con	ıpl. of module(s)	
3	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the at the beginning of the course. Registration for the cousidered a declaration of will to seek admission to assed dents have obtained the qualification for admission to the course of the semester, the lecturer will put their resessment into effect. Students who meet all prerequisited to assessment in the current or in the subsequent sessment at a later date, students will have to obtain admission to assessment anew.		ents about the respective details tion for the course will be con- nission to assessment. If stu- or admission to assessment over will put their registration for as- et all prerequisites will be admit- ne subsequent semester. For as-			
Contents					
Basics	of a me	odern programming langı	uage (e. g. C).		
	_	ning outcomes			
The stu	-	s able to work independe	ntly on small progran	nming exercises and	standard programming problem
Course	es (type, i	number of weekly contact hours,	language — if other than Ger	man)	
P (no i	nforma	tion on SWS (weekly cont	tact hours) and cours	e language available	e)
		<b>sessment</b> (type, scope, langua ole for bonus)	age — if other than German, o	examination offered — if no	ot every semester, information on whether
beginn	ing of t	form of programming exe the course) assessment: German, Eng			e specified by the lecturer at the
	tion of	<del>-</del>	,		
Additio	onal inf	ormation			
Worklo	oad				
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Modul	e appea	ars in			
Bachelor' degree (1 major) Nanostructure Technology (2012) Bachelor' degree (1 major) Economathematics (2012) Bachelor' degree (1 major) Mathematical Physics (2012) Bachelor' degree (1 major) Functional Materials (2012)					
First st	ate exa	mination for the teaching	g degree Gymnasium	Mathematics (2012)	



Module title					Abbreviation
Introdu	Introduction to Computer Science for Students of all Faculties			ies	10-I-EIN-111-m01
Module coordinator				Module offered by	
Dean o	f Studi	es Informatik (Computer	Science)	Institute of Comput	ter Science
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	Admission prerequi in exercises as spec		academic requirements to be met ng of the course.
Conten	its				
		of computer science inclu hms and data structures			rebsites (HTML, XML, EBNF), data-
Intend	ed learı	ning outcomes			
					e areas of representation of infor- tures, programming in Java.
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Ger	rman)	
V + Ü (ı	no infor	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
		<b>sessment</b> (type, scope, langu le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether
		mination (80 to 90 minu ion in groups of 2 or 3 ca			ate each (approx. 20 minutes) or
Allocat	ion of p	olaces			
Additio	onal inf	ormation			
Worklo	ad				
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)	
Module appears in					
	_	ree (1 major) Nanostruct	•, .	)	
	_	ree (1 major) Functional			
	_			nor 2012)	
	_	ee (1 major) Psychology gree (1 major, 1 minor) D		nor, 2012)	

Bachelor's degree (2 majors) Digital Humanities (2012)



Module	e title			Abbreviation	
Computational Mathematics				10-M-COM-122-m01	
Module coordinator				Module offered by	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
4	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 semester undergraduate		Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification admission to assessment anew.			

Introduction to modern mathematical software for symbolic computation (e.g., Mathematica or Maple) and numerical computation (e. g. Matlab) to supplement the basic modules in analysis and linear algebra ((10-M-ANA or 10-M-ANL) and 10-M-LNA). Computer-based solution of problems in linear algebra, geometry, analysis, in particular differential and integral calculus; visualisation of functions.

# **Intended learning outcomes**

The student learns the use of advanced modern mathematical software packages, and is able to assess their fields of application to solve mathematical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

project in the form of programming exercises (type and expenditure of time to be specified by the lecturer at the beginning of the course)

Language of assessment: German, English if agreed upon with the examiner

# Allocation of places

## **Additional information**

# Workload

# **Teaching cycle**

# $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$

# Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2012)

Bachelor' degree (1 major) Economathematics (2012)

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

Bachelor' degree (1 major) Functional Materials (2012)

First state examination for the teaching degree Gymnasium Mathematics (2012)



Modul	e title			Abbreviation		
Modelling and Computational Science				10-M-MWR-122-m01		
Module coordinator				Module offered by		
Dean c	f Stud	ies Mathematik (Mat	hematics)	Institute of Mathematics		
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
10	nume	erical grade				
Duratio	on	Module level	Other prerequisite	Other prerequisites		
1 semester undergraduate		sessment. The lect at the beginning of sidered a declaration dents have obtained the course of the sessment into effected to assessment	es must be met to qualify for admission to as- urer will inform students about the respective details the course. Registration for the course will be con- on of will to seek admission to assessment. If stu- d the qualification for admission to assessment over emester, the lecturer will put their registration for as- ct. Students who meet all prerequisites will be admit- in the current or in the subsequent semester. For as- date, students will have to obtain the qualification for esment anew.			

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.

### **Intended learning outcomes**

The student masters the fundamental mathematical methods and techniques to simulate processes from natural and engineering sciences on a computer.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 to 180 minutes)

if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes) Language of assessment: German, English if agreed upon with the examiner

# Allocation of places

#### **Additional information**

# Workload

# Teaching cycle

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

### Module appears in

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

Bachelor' degree (1 major) Computational Mathematics (2012)

Bachelor' degree (1 major) Computational Mathematics (2013)



Module	e title				Abbreviation
Mathe	matics	4 for Students of Physics	and Engineering		11-MPI4-062-m01
Module	Module coordinator			Module offered by	-
Manag and As	-	ector of the Institute of Th	neoretical Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	its		•		
Functio	nal an	alysis and complex analy	sis.		
Intend	ed lear	ning outcomes			
		have basic knowledge of as the required calculation		ert space and the th	eory of functions of a complex va-
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ge	rman)	
V + Ü (ı	no info	rmation on SWS (weekly	contact hours) and co	ourse language avail	lable)
module is	s creditab exami	ole for bonus) nation (approx. 120 minu			ot every semester, information on whether
Additio	nal inf	ormation			
Worklo	ad				
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	ammes)	
Module	e appea	ars in			
Bachel Bachel Bachel Bachel Bachel	or' deg or' deg or' deg or' deg or' deg	ree (1 major) Physics (2007) ree (1 major) Physics (2007) ree (1 major) Physics (2007) ree (1 major) Nanostructu	09) 08) Ire Technology (2010 Ire Technology (2012 Ire Technology (2008	) 3)	



Module title					Abbreviation
Current	Current Topics in Nanostructure Technology				11-BXN6-112-m01
Module coordinator				Module offered by	
		f examination committee		Faculty of Physics a	and Astronomy
ECTS		od of grading	Only after succ. con	· · · · · · · · · · · · · · · · · · ·	•
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.
Conten	its				
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university
Intend	ed lear	ning outcomes			
nology ledge.	or nan They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	odiscipline of nanostructure techs s necessary to acquire this know- ication areas.
		mation on SWS (weekly o			able)
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, (	examination offered — if no	ot every semester, information on whether
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4
Allocat		_			
Additio	onal inf	ormation			
Worklo	ad				
Teachi	ng cycl	e			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	ars in			
	_	ree (1 major) Nanostructu	•, .		
Bachelor' degree (1 major) Nanostructure Technology (2012)					



Module title					Abbreviation
Current	Current Topics in Nanostructure Technology				11-BXN5-112-m01
Module coordinator				Module offered by	l.
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.
Conten	ts		,		
Current or stud	•		. Accredited academi	c achievements, e.g.	. in case of change of university
Intend	ed learı	ning outcomes			
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	l evaluation method and know the appli	odiscipline of nanostructure techs necessary to acquire this knowication areas.
V + R (r	no infor	mation on SWS (weekly o	contact hours) and co	urse language avail	able)
		<b>Sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4
Allocat					
Additio	nal inf	ormation			
Worklo	ad				
Teaching cycle					
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	ars in			
	_	ree (1 major) Nanostructu			
Bachelor' degree (1 major) Nanostructure Technology (2012)					



Module title					Abbreviation	
Current	Current Topics in Nanostructure Technology				11-BXN8-112-mo1	
Module coordinator				Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
Current or stud			. Accredited academi	c achievements, e.g.	. in case of change of university	
Intende	ed lear	ning outcomes				
nology ledge.	or nand They ar		nd the measuring and ject-specific contexts	d evaluation method and know the appli	discipline of nanostructure techs necessary to acquire this know-cation areas.	
		mation on SWS (weekly contact nours, t			abla)	
a) writti in grou weeks)	en exar ps (app or d) p	le for bonus) mination (approx. 120 mi	nutes) or b) oral exar didate) or c) project ro sentation (approx. 30	nination of one cand eport (approx. 8 to 10	lidate each or oral examination on whether or oral examination o pages, time to complete: 1 to 4	
Allocat						
Additio	nal inf	ormation	•			
Worklo	ad					
-						
Teaching cycle						
<del></del>						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
<del></del>						
Module	e appea	rs in				
	Bachelor' degree (1 major) Nanostructure Technology (2010)					
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)					



Module title Abbreviation					Abbreviation
Current	Topic	s in Physics			11-BXP5-112-m01
Module	Module coordinator			Module offered by	
chairpe	rson o	f examination committee		Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.
Conten	ts				
		of Experimental and The versity or study abroad.	oretical Physics. Acc	redited academic ac	hievements, e.g. in case of
Intende	ed lear	ning outcomes			
Theoret subdisc	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology. d/or calculation met	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V + R (n	o infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether
in grou weeks)	ps (app or d) p		didate) or c) project re sentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
Teaching cycle					
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	appea	ars in			
Bachel	or' deg	ree (1 major) Nanostructu	ıre Technology (2012)	)	



Module title Abbreviation						
Current Topics in Physics 11-BXP6-112-mo1						
Module coordinator		Module offered by				
chairperson of examination comr	nittee	Faculty of Physics a	and Astronomy			
ECTS Method of grading	Only after succ. con		·			
6 numerical grade		•				
Duration Module level	Other prerequisites					
1 semester undergraduate	Approval by examin	ation committee req	uired.			
Contents	•					
Current topics of Experimental an change of university or study abro		redited academic ac	hievements, e.g. in case of			
Intended learning outcomes						
The students have advanced com Theoretical Physics of the Bachel subdiscipline of Physics and und knowledge. They are able to class	or's programme of Nanost erstand the measuring and	ructure Technology. d/or calculation met	They have knowledge of a current hods necessary to acquire this			
Courses (type, number of weekly contact	hours, language — if other than Ge	rman)				
V + R (no information on SWS (we	ekly contact hours) and co	ourse language avail	able)			
<b>Method of assessment</b> (type, scope, module is creditable for bonus)	language — if other than German,	examination offered — if no	ot every semester, information on whether			
in groups (approx. 30 minutes pe weeks) or d) presentation/semina	a) written examination (approx. 120 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Language of assessment: German or English					
Allocation of places						
Additional information						
Workload						
Teaching cycle						
<u> </u>						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
	<u></u>					
Module appears in						



Module	Module title Abbreviation					
Current	Current Topics in Physics 11-BXP8-112-mo1					
Module	Module coordinator Mod			Module offered by		
chairperson of examination committee			?	Faculty of Physics and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	ıpl. of module(s)		
8	numerical grade					
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate	Approval by examin	ation committee req	uired.	
Conten	ts					
		of Experimental and The versity or study abroad.	eoretical Physics. Acc	redited academic ac	hievements, e.g. in case of	
Intende	ed learı	ning outcomes				
Theore:	tical Ph cipline	ysics of the Bachelor's p	rogramme of Nanosti nd the measuring and	ructure Technology.  I/or calculation metl	of a module of Experimental or They have knowledge of a current hods necessary to acquire this application areas.	
Course	<b>S</b> (type, n	number of weekly contact hours,	language — if other than Ger	rman)		
V + R (r	o infor	mation on SWS (weekly	contact hours) and co	urse language avail	able)	
		sessment (type, scope, langua le for bonus)	nge — if other than German, o	examination offered — if no	ot every semester, information on whether	
in grou weeks)	ps (app or d) p		didate) or c) project resentation (approx. 30	eport (approx. 8 to 1	lidate each or oral examination o pages, time to complete: 1 to 4	
Allocat	ion of p	olaces				
Additio	Additional information					
Worklo	Workload					
<del> </del>						
Teaching cycle						
<del></del>						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
	<del></del>					
Module	Module appears in					



Modul	Module title Abbreviation						
Statistics, Data Analysis and Computer Physics					11-SDC-131-m01		
Modul	Module coordinator			Module offered by	Module offered by		
Managing Director of the Institute of Applied Physics		of Applied Physics	Faculty of Physics and Astronomy				
ECTS		od of grading	Only after succ. con		•		
4	nume	rical grade					
Duration Module level Other pre		Other prerequisites	1				
1 semester graduate		sessment. The lecturation at the beginning of sidered a declaration dents have obtained the course of the sessment into effect	Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semesters.				
Conter	nts		<b>,</b>		·		
Statist	ics, dat	a analysis and comp	outer physics.				
Intend	ed lear	ning outcomes	· · ·				
The stu Physic		have specific and ad	vanced knowledge in the	field of statistics, da	ata analysis and Computational		
Course	es (type, i	number of weekly contact h	ours, language — if other than Ge	rman)			
V + R (ı	no info	rmation on SWS (wee	ekly contact hours) and co	ourse language avail	able)		
		sessment (type, scope, l	anguage — if other than German,	examination offered — if n	ot every semester, information on whether		
in grou weeks) Assess and wi examir	a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)  Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.  Language of assessment: German, English						
	tion of						
Additio	onal inf	ormation					
Workload							
Teaching cycle							
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)						
	<del></del>						
	Module appears in						
			ructure Technology (2010				
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2012)						



Module title					Abbreviation	
Statist	ics, Da	ta Analysis and Comput	er Physics		11-SDC-092-m01	
Module	Module coordinator			Module offered by		
Manag	ing Dire	ector of the Institute of A	applied Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
4	nume	rical grade				
Duratio	on	Module level	Other prerequisites	Other prerequisites		
1 semester graduate		Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.				
Conten	its					

Statistics, data analysis and computer physics.

# Intended learning outcomes

The students have specific and advanced knowledge in the field of statistics, data analysis and Computational Physics.

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

R + V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

#### Allocation of places

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# Additional information

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# Workload

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# **Teaching cycle**

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 $\textbf{Referred to in LPO I} \ \ (\text{examination regulations for teaching-degree programmes})$ 

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# Module appears in

Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)



Bachelor' degree (1 major) Nanostructure Technology (2012)

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

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

Master's degree (1 major) Mathematics (2012)

Master's degree (1 major) Mathematics (2010)

Master's degree (1 major) Physics (2010)

Master's degree (1 major) Physics (2011)

Master's degree (1 major) Nanostructure Technology (2011)

Master's degree (1 major) Nanostructure Technology (2010)

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

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

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

Master's degree (1 major) Computational Mathematics (2012)



# **Thesis**

(20 ECTS credits)

The grade awarded for the thesis will count double in the calculation of the overall grade of the Bachelor's degree.



Module title					Abbreviation	
Bachelor Thesis Nanostructure Technology 11-BA-N-072-m01					11-BA-N-072-m01	
Module coordinator Module o			Module offered by	offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. com	ıpl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conter	its					
					ask in the field of nanostructure riting of the Bachelor's thesis.	
Intend	ed lear	ning outcomes	·	·		
structu	re tech		ce of a supervisor, es	pecially in accordan	d engineering task from nano- ce with known methods and	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
no cou	rses as	signed				
		sessment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
written	thesis	(approx. 25 pages)				
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
Teachi	ng cycl	e				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Bachelor' degree (1 major) Nanostructure Technology (2010)						
	_	ree (1 major) Nanostructu				
	Bachelor' degree (1 major) Nanostructure Technology (2008)					
Bachel	Bachelor' degree (1 major) Nanostructure Technology (2007)					



# **Subject-specific Key Skills**

(16 ECTS credits)



Module title				Abbreviation	
Mathematical Methods of Physics					11-P-MR-092-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Theoretical and Astrophysics		neoretical Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	6 (not) successfully completed				
Duration Module level Other prerequ		Other prerequisites			
2 semester undergraduate					
Conten	Contents				

Principles of mathematics and basic calculation methods beyond the school curriculum, especially for the introduction to and preparation of the modules of Theoretical Physics and Classical or Experimental Physics. Repetition of basic knowledge, functions of several real variables, differential equations, linear algebra, vector analysis, other (delta distribution, Fourier transform).

# **Intended learning outcomes**

The students have knowledge of the principles of mathematics and elementary calculation methods which are required in Theoretical and Experimental Physics. They are able to apply these methods to simple problems, especially in the field of Physics.

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

Mathematische Rechenmethoden 1 (Mathematical Methods 1): V (2 weekly contact hours) + Ü (1 weekly contact hour), once a year (winter semester)

Mathematische Rechenmethoden 2 (Mathematical Methods 2): V (2 weekly contact hours) + Ü (1 weekly contact hour), once a year (summer semester)

 $\textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination offered} - \textbf{if not every semester, information on whether} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{scope}, \textbf{language} - \textbf{if other than German, examination of the every semester)} \\ \textbf{Method of assessment} \ (\textbf{type}, \textbf{language} - \textbf{langua$ module is creditable for bonus)

This module has the following assessment components

- 1. Topics covered in lectures and exercises in part 1 (Mathematische Rechenmethoden 1 (Mathematical Methods 1)): exercises or talk (approx. 15 minutes, usually chosen) or written examination (approx. 60 minutes)
- 2. Topics covered in lectures and exercises in part 2 (Mathematische Rechenmethoden 2 (Mathematical Methods 2)): exercises or talk (approx. 15 minutes, usually chosen) or written examination (approx. 60 minutes)

Successful completion of approx. 50% of practice work each is a prerequisite for admission to assessment components 1 and 2.

Students must register for assessment components 1 and 2 online (details to be announced).

To pass this module, students must pass both assessment component 1 and assessment component 2.

#### Allocation of places

# Additional information

# Workload

# **Teaching cycle**

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

§ 53 (1) 1. a) Physik Mechanik, Wärmelehre, Elektrizitätslehre, Optik, der speziellen Relativitätstheorie § 77 (1) 1. a) Physik "Grundlagen der Experimentalphysik"

# Module appears in

Bachelor's with 1 major Nanostructure Technology	JMU Würzburg • generated 26-Aug-2024 • exam. reg. da-	page 185 / 187
(2012)	ta record Bachelor (180 ECTS) Nanostrukturtechnik - 2012	



Bachelor' degree (1 major) Physics (2010)

Bachelor' degree (1 major) Physics (2012)

Bachelor' degree (1 major) Nanostructure Technology (2012)

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

Bachelor's degree (1 major, 1 minor) Physics (Minor, 2010)



Module title					Abbreviation	
Industrial Practical Course Nanostructure Technology			ure Technology		11-IP-092-m01	
Modul	Module coordinator			Module offered by		
Managing Director of the Institute of Applied Physics			pplied Physics	Faculty of Physics and Astronomy		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade	11-EIN and 11-KP			
Duratio	on	Module level	Other prerequisites			
1 seme	Semester undergraduate Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective detat the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment the course of the semester, the lecturer will put their registration for sessment into effect. Students who meet all prerequisites will be added to assessment in the current or in the subsequent semester. For sessment at a later date, students will have to obtain the qualification.		nts about the respective details ion for the course will be consission to assessment. If sturadmission to assessment over will put their registration for astall prerequisites will be admite subsequent semester. For as-			
Conter	nts		admission to assess	sineit unew.		
Insight	ts into i	ndustrial methods, work report and an oral prese		I production method	s. Summary of own experiences	
		ning outcomes	- Tradion.			
	_		ctical experience of u	sing a variety of indu	ustrial technologies with relevan-	
					report and an oral presentation.	
Course	es (type,	number of weekly contact hours,	language — if other than Ger	rman)		
P + S (ı	no info	rmation on SWS (weekly	contact hours) and co	urse language avail	able)	
		sessment (type, scope, langua ole for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess and wi	sment o	offered: When and how of	ften assessment will l	oe offered depends o	o minutes), weighted 1:4 on the method of assessment 3 ASPO (general academic and	
	tion of					
Additio	Additional information					
Worklo	Workload					
<del></del>						
Teaching cycle						
	<del></del>					
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in						
	Bachelor' degree (1 major) Nanostructure Technology (2010) Bachelor' degree (1 major) Nanostructure Technology (2012)					
Dactie	Dachelor degree (1 major) Nanostructure recimology (2012)					