

### Module Catalogue

for the Subject

### Physics

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

Examination regulations version: 2007 Responsible: Faculty of Physics and Astronomy

JMU Würzburg • generated 23-Aug-2021 • exam. reg. data record 82|128|-|-|H|2007

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#### The subject is divided into

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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 physics and to make the students familiar with the methods of physical 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 experimental and theoretical physical terms and laws as well as on basic scientific methods and the development of the typical scientific thinking and working structures. During the Bachelor thesis the student should work on a thematic and temporally limited experimental or theoretical engineering-scientific task in the field of experimental or theoretical physics using well-known procedures and scientific criteria under guidance to a large extent independently.

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#### **Abbreviations used**

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

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

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

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

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

#### Conventions

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

#### Notes

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

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

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

#### In accordance with

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

#### ASPO2007

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

#### 8-Apr-2008 (2008-6)

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.

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### **Compulsory Courses**

(140 ECTS credits)

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### **Experimental Physics**

(46 ECTS credits)

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Module	Module title Abbreviation				
Experir ons)	Experimental Physics 1 (Mechanics, Thermodynamics, Waves and Oscillati- ons)				
Module	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Physica	al laws	of mechanics, vibrations	and waves, thermod	ynamics	
Intende	ed lear	ning outcomes			
The stu	dents	understand the basic cor	texts and principles	of mechanics, vibrat	ion, waves and thermodynamics.
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
Method module is	<b>d of ass</b> creditab	<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
written	exami	nation (approx. 120 minu	tes)		
Allocation of places					
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

Module title					Abbreviation
Experimental Physics 2 (Electrics and Magnetism) 11-E2-072-m01					
Module	e coord	inator		Module offered by	
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	ind 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			
Conten	ts				
Physica	al laws	of the science of electric	ity, magnetism, elect	romagnetic vibration	is and waves
Intende	ed lear	ning outcomes			
The stu vibratio	dents ons and	understand the basic cor I waves.	itexts and principles	of science of electric	ity, magnetism, electromagnetic
Course	<b>S</b> (type, r	number of weekly contact hours, I	anguage — if other than Gei	rman)	
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	it every semester, information on whether
written	exami	nation (approx. 120 minu	tes)		
Allocation of places					
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

Module	Module title Abbreviation				
Experimental Physics 3 (Optics, Quantum Phenomena, Introduction Atomic       11-E3-072-m01         Physics)       11-E3-072-m01					
Module	coord	inator		Module offered by	
Managi	ng Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Physica	ıl laws	of optics, quantum phen	omena, introduction	to Atomic Physics.	
Intende	ed lear	ning outcomes			
The stu Physics	dents   5.	have knowledge of the ba	asic contexts and prir	iciples of optics, qua	antum phenomena and Atomic
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
Methoo module is	<b>l of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
written	exami	nation (approx. 120 minu	tes)		
Allocation of places					
Additional information					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					

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Module	Module title Abbreviation					
Experin	Experimental Physics 4 (Introduction to Solid State Physics)11-E4-072-m01					
Module	e coord	inator		Module offered by		
Managi	ng 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)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Physica perties	al laws (free e	of solids: Bonding and st lectron gas).	ructure, lattice dyna	nics, thermal proper	ties, principles of electronic pro-	
Intende	ed lear	ning outcomes				
The stu mics, th	dents l nermal	have knowledge of the ba properties, principles of	asic contexts and prir electronic properties	nciples of solids: Bor (free electron gas).	nding and structure, lattice dyna-	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Methoo module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
written	examiı	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						

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Module title Abbreviation					Abbreviation	
Experin	Experimental Physics 5 (Physics of Atoms and Molecules) 11-E5-072-m01					
Module	e coord	inator		Module offered by		
Managi	ng Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Physica	al laws	of Atomic and Molecular	Physics.			
Intende	ed leari	ning outcomes				
The stu Quantu well as	dents l m mec moleci	nave knowledge of the ba hanical atom model, one ules: Bonding models an	asic contexts and prir /multi-electron atom d elementary excitati	nciples of Atomic and s, electronic dipole ons: rotations, vibra	d Molecular Physics (atoms: transitions, atoms in B field as tions, electronic excitations)	
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Methoo module is	<b>d of ass</b> creditab	e <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
written	examiı	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		

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Module title					Abbreviation	
Nuclear and Elementary Particle Physics         11-E6-072-m01					11-E6-072-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
4	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Physica	al laws	of Nuclear and Elementa	ry Particle Physics.			
Intende	ed lear	ning outcomes				
The stu	dents	have knowledge of the ba	asic contexts and prir	nciples of Nuclear an	d Elementary Particle Physics.	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
written	exami	nation (approx. 120 minu	tes)			
Allocat	Allocation of places					
Additional information						
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		

Module title Abbreviation					Abbreviation	
Experimental Physics 7 (Solid State Phenomena [Semiconductor, Supercon- ductivity, Magnetism])       11-E7-072-m01						
Module	Module coordinator Module offered by					
Managi	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
4	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Physica	al laws	of solid-state phenomen	a (semiconductors, s	uperconductivity, m	agnetism)	
Intende	ed lear	ning outcomes				
The stu ties (se menolo tic orde	dents   mi-con ogical n er)	have knowledge of the ba ductors: Doping effects, nodels, BCS model; mag	asic contexts and prir pn transitions, metal netism: Dia-, para- an	nciples of electronic -semiconductor inte nd ferromagnetism, r	transport and electrical proper- rfaces; superconductivity: pheno- nean field description of magne-	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no info	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Methoo module is	<b>d of ass</b> creditab	<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	
written	exami	nation (approx. 120 minu	tes)			
Allocation of places						
Additional information						
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		



### **Theoretical Physics**

(32 ECTS credits)

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Module title					Abbreviation	
Theore	Theoretical Physics 1 (Theoretical Mechanics)       11-T1-072-m01					
Module	e coord	inator		Module offered by		
Managi and As	ing Dire trophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Newtor	nian me	echanics, Lagrangian mee	chanics, Hamiltonian	equation of motion,	conservation laws.	
Intende	ed lear	ning outcomes				
The stu methoo	idents l ds.	have knowledge of the pr	inciples of classical t	heoretical mechanic	s and the required calculation	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infoi	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
written	exami	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						

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Module	e title			Abbreviation		
Theore	Theoretical Physics 2 (Theoretical Electrostatics and Elektrodynamics)       11-T2-072-m01					
Module	e coord	inator		Module offered by		
Managi and As	ing Dire trophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Electro	statics,	magnetostatics, Maxwe	ll equations, covariar	nt formulation, electr	odynamics and matter.	
Intende	ed lear	ning outcomes				
The stu thods.	dents l	have knowledge of the pr	inciples of classical e	electrodynamics and	the required calculation me-	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<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	
written	exami	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						

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Module title					Abbreviation
Theoretical Physics 3 (Theoretical Quantum Mechanics)       11-T3-072-m01					11-T3-072-m01
Module	e coord	inator		Module offered by	
Manag and As	ing Dire trophys	ector of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Limits o oscillat	of class or, ang	ical physics, Schrödinge ular momentum and spir	r equation, mathema n, hydrogen atom, ma	tical foundations of any-particle systems	quantum mechanics, harmonic
Intende	ed learı	ning outcomes			
The stu	dents l	nave knowledge of the pr	inciples of quantum	mechanics and the r	equired calculation methods.
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
Method module is	<b>d of ass</b> creditab	s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether
written	exami	nation (approx. 120 minu	tes)		
Allocat	ion of p	olaces			
Additional information					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					

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Module title Abbreviation					Abbreviation	
Theore	Theorectical Physics 3 FOKUS (Theoretical Quantum Mechanics)       11-T3F-072-m01					
Module	e coord	inator		Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics			eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Limits o oscillat	of class or, ang	ical physics, Schrödinge Jular momentum and spir	r equation, mathema 1, hydrogen atom, ma	tical foundations of any-particle systems	quantum mechanics, harmonic	
Intende	ed learı	ning outcomes				
The stu	dents l	nave knowledge of the pr	inciples of quantum	mechanics and the r	required calculation methods	
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<b>eessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
written	exami	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					

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Module	Module title Abbreviation					
Theore	Theorectical Physics 4 (Theoretical Thermodynamics and Statistics)       11-T4-072-m01					
Module	e coord	inator		Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics			eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Princip chanics	les of tl 5.	hermodynamics, fundam	ental theorems, then	modynamic potentia	ls, principles of statistical me-	
Intende	ed leari	ning outcomes				
The stu calcula	dents l tion me	have knowledge of the pr ethods.	inciples of thermody	namics and statistic	al mechanics and the required	
Course	<b>S</b> (type, n	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	it every semester, information on whether	
written	exami	nation (approx. 120 minu	tes)			
Allocat	ion of p	olaces				
Additional information						
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	immes)		

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### Lab Course Physics

(16 ECTS credits)

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Module	Module title			Abbreviation	
Basic Practical Course B for Students of Physics (Bachelor of Science and Tea- ching Degree)			11-PGA-PGR-072-m01		
Module coordinator Module offered					
Managi	ng Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
6	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate	Recommended: 11-P	FR	
Conten	ts				
Physica	al laws	of mechanics, thermodyr	namics, optics, sciend	ce of electricity, vibr	ations and waves.
Intende	ed lear	ning outcomes			
The stu are able in a me	dents l e to inc asuren	have knowledge and skill lependently plan and cor nent protocol.	s of physical measur nduct experiments in	ing instruments and cooperation with otl	experimental techniques. They hers, and to document the results
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
Beispie BAM): F Klassis Elektriz	le aus P (2 we che Ph itätsle	Mechanik, Wärmelehre u ekly contact hours) ysik (Classical Physics, K hre und Schaltungen (Ele	nd Elektrik (Example LP): P (2 weekly conta ctricity and Circuits, I	s from Mechanics, T act hours) ELS): P (2 weekly cor	hermodynamics and Electricity, ntact hours)
Methoo module is	<b>l of ass</b> creditab	sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether
<ul> <li>module is creditable for bonus)</li> <li>This module has the following assessment components</li> <li>1. Lab course in part 1: 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).</li> <li>2. Lab course in part 2: 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).</li> <li>3. Lab course in part 3: 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).</li> <li>3. Lab course in part 3: 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).</li> <li>3. Lab course in part 3: 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).</li> <li>3. Lab course in part 3: a) Preparing, performing and evaluating the experiments will be considered successfully complete at the students' understanding of the physics-related contents of the course (approx. 30 minutes).</li> <li>3. Lab course in part 3: a) Preparing, performing and evaluating the experiments will be considered successfully.</li> <li>3. Lab course in part 3: a) Preparing, performing and and/or element b). To pass an assessment component, they must pass b</li></ul>					
Allocation of places					
Additional information					
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	

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Module title					Abbreviation
Advanc Semico	Advanced Undergraduate Laboratory (Atomic Physics, Nuclear Physics, Basic         11-PGB-PGN-072-m01           Semicondutor Circuits)				
Module	e coord	inator		Module offered by	
Managi	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
4	(not) s	successfully completed	11-PFR		
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate	Recommended: 11-P	GA-PGR	
Conten	ts				
Physica and sto	al laws prage o	of Atomic Physics, Nucles scilloscopes.	ar Physics and wave o	optics. Basic measu	ring methods using computers
Intende	ed lear	ning outcomes			
The stu are able in a me	dents l e to inc asuren	have knowledge and skill lependently plan and cor nent protocol.	s of physical measur iduct experiments in	ing instruments and cooperation with otl	experimental techniques. They hers, and to document the results
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
Wellen Atom- u Compu	optik (F und Kei ter und	Physical Optics, WOP): P ( mphysik (Atomic and Nuc I Messtechnik (Computer	(2 weekly contact hou clear Physics, AKP): P s and Measurement T	urs) (2 weekly contact h Fechnology, CMT): P	ours) (2 weekly contact hours)
Method	d of ass	sessment (type, scope, langua	ge — if other than German, e	examination offered — if no	t every semester, information on whether
module is	creditab	le for bonus)			
<ul> <li>This module has the following assessment components</li> <li>1. Lab course in part 1: 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).</li> <li>2. Lab course in part 2: 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).</li> </ul>					
Students must register for assessment components 1 and 2 online (registration deadline to be announced). Students will be offered one opportunity to retake element a) and/or element b). To pass an assessment compo- nent, they must pass both elements a) and b). To pass this module, students must successfully complete two out of the three courses. To pass this module, students must pass both assessment component 1 and assessment component 2.					
Allocation of places					
Additional information					
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	

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Module title			Abbreviation		
Advanced Practical Course Bachelor					11-PFB-072-m01
Module coordinator Module offered b					
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. com	npl. of module(s)	
4	(not) s	successfully completed	11-E1, 11-E2		
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	11-A3		
Conten	ts				
Princip stems,	les of N proper	luclear, Atomic and Mole ties of solids, surfaces a	cular Physics, experi nd interfaces.	ments on cryogenic t	temperatures and correlated sy-
Intende	ed lear	ning outcomes			
The stu results. They ar	idents l . They l e able	have knowledge of condunave basic knowledge of to work on a task based of	ucting an experiment issuing a scientific pu on publications and t	and of analysing and ublication and of usi o acquire practical e	d documenting the experimental ng modern evaluation systems. xperimental methods.
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
Fortges hour) Fortges hours)	chritte chritte	nen-Praktikum Bachelor nen-Praktikum Bachelor	Theorie (Advanced Pr Praxis (Advanced Pra	actical Course Bache	elor Theory): S (1 weekly contact or Practice): P (3 weekly contact
<b>Method</b> module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
<ul> <li>This module has the following assessment components</li> <li>Seminar: talk (with discussion) demonstrating the students' understanding of the physics-related aspects of the experiments to be prepared (approx. 30 minutes)</li> <li>Lab course: Preparing, performing and evaluating the experiments will be considered successfully completed if a Testat (exam) is passed. Students must prepare an experiment log (8 to 10 pages).</li> </ul>					
Studen To pass	ts mus s this m	t register for assessment odule, students must pa	components 1 and 2 iss both assessment	online (details to be component 1 and as	e announced). sessment component 2.
Allocation of places					
Additional information					
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	

Module title					Abbreviation	
Main Seminar Experimental / Theoretical Physics					11-PHS-072-m01	
Module	e coord	inator		Module offered by		
Managing Directors of the Institute of Applied Physics and the Institute of Theoretical Physics and Astrophysics			Applied Physics and Astrophysics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
2	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Current	issues	of Theoretical/Experime	ntal Physics.			
Intende	ed lear	ning outcomes				
The stu of Theo	dents l retical	have knowledge of the so or Experimental Physics.	ientific methods, wo	rk and presentation	techniques of a current question	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
S (no ir	format	ion on SWS (weekly cont	act hours) and cours	e language available	2)	
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
talk (ap	prox. 3	30 to 45 minutes) with dis	scussion			
Allocat	ion of p	olaces				
Additional information						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						

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#### Mathematics (34 ECTS credits)

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Module title				Abbreviation	
Mathematics 3 for students of Physics and Engineering			and Engineering		11-MPI3-062-m01
Module	Module coordinator			Module offered by	
Managi and Ast	ing Dire trophys	ector of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semesterundergraduateAdmission pr 50% of exercision to asses ve details at the be considere students hav over the cour assessment i mitted to ass assessment a			Admission prerequis 50% of exercises. Co sion to assessment. ve details at the beg be considered a dec students have obtai over the course of th assessment into effe mitted to assessment assessment at a late for admission to ass	site to assessment: s ertain prerequisites i . The lecturer will info ginning of the course :laration of will to se ned the qualification he semester, the lect ect. Students who m nt in the current or ir er date, students will sessment anew.	successful completion of approx. must be met to qualify for admis- orm students about the respecti- . Registration for the course will ek admission to assessment. If n for admission to assessment curer will put their registration for eet all prerequisites will be ad- n the subsequent semester. For I have to obtain the qualification
Conten	ts				
Ordinar	ry and p	partial differential equati	ons in Physics.		
Intende	ed learr	ning outcomes			
The stu partial	dents l differer	nave basic mathematical ntial equations.	knowledge of dynam	ic equations and so	lution methods for common and
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
Methoo module is	<b>d of ass</b> creditab	s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
written	examir	nation (approx. 120 minu	tes)		
Allocation of places					
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

Module	Module title Abbreviation					
Mathe	Mathematics for Physicists 1       10-M-PHY1-072-m01					
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Basics spaces	on nun , simpl	nbers and functions, seque differential equations.	uences and series, di	fferential and integra	al calculus in one variable, vector	
Intende	ed lear	ning outcomes				
The stu ple pro	ident g blems	ets acquainted with basic in natural sciences, in pa	c concepts of mathen rticular in physics, ar	natics. He/She learn nd is able to interpre	s to apply these methods to sim- t the results.	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Metho module is	<b>d of ass</b> s creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
written	exami	nation (90 minutes)				
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						

Module	Module title Abbreviation						
Mather	Mathematics for Physicists 2 10-M-PHY2-072-m01						
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics		
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)			
8	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	undergraduate					
Conten	ts						
Linear ı lus in s	maps a everal	nd systems of linear equ variables, differential equ	ations, matrix calculu uations, Fourier analy	us, eigenvalue theory vsis.	y, differential and integral calcu-		
Intende	ed lear	ning outcomes					
The stu se metl	ident g hods to	ets acquainted with fund problems in natural scie	amental concepts of ences, in particular in	advanced mathemat physics, and is able	tics. He/She learns to apply the- to interpret the results.		
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)			
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)		
Methoo module is	<b>d of ass</b> s creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether		
written	exami	nation (90 minutes)					
Allocat	ion of <sub>l</sub>	olaces					
Additional information							
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							

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Module title					Abbreviation	
Mather	Mathematics 4 for Students of Physics and Engineering       11-MPI4-062-m01					
Module	e coord	inator		Module offered by		
Manag and As	ing Dire trophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd 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				
Conten	ts					
Functio	nal ana	alysis and complex analy	sis.			
Intende	ed lear	ning outcomes				
The stu riable a	dents l is well	have basic knowledge of as the required calculatio	mathematics of Hilbe on methods.	ert space and the the	eory of functions of a complex va-	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)	
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
written	exami	nation (approx. 120 minu	tes)			
Allocation of places						
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						

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### Module Comprehensive Tests

(12 ECTS credits)

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Module	Module title Abbreviation				
Oral Ex	Oral Exam Experimental Physics (Physicists) 11-PREP-072-m01				
Module	e coord	inator		Module offered by	
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
The pu tal and	rpose o Applie	f the examination is to d d Physics and is able to a	etermine whether the apply the acquired sc	e candidate understa ientific methods.	ands basic contexts of Experimen-
Intende	ed lear	ning outcomes			
The stu apply t	idents l he acqi	have gained an overview uired scientific methods.	of the basic contexts	of Experimental and	d Applied Physics and are able to
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
A (no ir	format	ion on SWS (weekly cont	act hours) and cours	e language available	2)
Method module is	<b>d of ass</b> creditab	<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
oral exa	aminat	ion of one candidate eac	h (approx. 30 minute	s)	
Allocat	ion of p	olaces			
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

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Module	Module title Abbreviation					
Oral Ex	Oral Exam Theoretical Physics 11-PRT-072-m01					
Module	e coord	inator		Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
The pu Physics	rpose o s and is	f the examination is to d able to apply the acquir	etermine whether the ed scientific methods	e candidate understa 5.	ands basic contexts of Theoretical	
Intende	ed lear	ning outcomes				
The stu quired	dents l scienti	have gained an overview fic methods.	of the basic contexts	of Theoretical Physi	cs and are able to apply the ac-	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
A (no ir	nformat	ion on SWS (weekly cont	act hours) and cours	e language available	2)	
<b>Method</b> module is	<b>d of ass</b> creditab	<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	
oral exa	aminat	ion of one candidate eac	h (approx. 30 minute	s)		
Allocat	ion of p	olaces				
Additional information						
Referred to in LPO I (examination regulations for teaching-degree programmes)						

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### **Compulsory Electives**

(10 ECTS credits)

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# **Chemistry** (10 ECTS credits)

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Module title			Abbreviation		
General Chemistry for Physics and Engineers			08-CP1-072-m01		
Module coordinator				Module offered by	
lecture	r of the	course	_	Institute of Inorgani	ic Chemistry
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
This mo student	dule d	iscusses the fundamenta pportunity to learn esser	al principles of both i ntial methods and pe	norganic and organic rform simple experir	c chemistry. The lab course gives nents.
Intende	ed learr	ning outcomes			
Studen to expla cal form le to ide	ts are a ain bas nulas to entify fu	ble to explain the princip ic models of the structure describe chemical react undamental problems in	bles of the periodic ta e of matter. They have tions and to interpret chemistry and perfor	ble and to extract in e developed the abil them by identifying m experiments to so	formation from it. They are able ity to use the language of chemi- the type of reaction. They are ab- lve them.
Course	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
This mo compor o o o o	odule co nent. 8-IOC-1 8-CP1-1 8-CP1-1	omprises 3 module comp 1-072: V (no information o 1-072: V (no information o 3-072: P (no information o	oonents. Information on SWS (weekly conta on SWS (weekly conta on SWS (weekly conta	on courses will be lis act hours) and cours act hours) and cours act hours) and cours	sted separately for each module e language available) e language available) e language available)
Method	l of ass	essment (type, scope, langua	ge — if other than German, e	examination offered — if no	t every semester, information on whether
module is	creditab	le for bonus)			
Assessi low. Un vidual a	ment ir less sta assessr	i this module comprises ated otherwise, successf nents.	the assessments in t ul completion of the	he individual module module will require s	e components as specified be- successful completion of all indi-
<ul> <li>Assessment in module component o8-IOC-1-072: Organic Chemistry for students of medicine, biomedicine, dental medicine, engineering and natural science <ul> <li>3 ECTS, Method of grading: numerical grade</li> <li>written examination (approx. 60 minutes)</li> </ul> </li> <li>Assessment in module component o8-CP1-1-072: Basics of General an Inorganic Chemistry <ul> <li>5 ECTS, Method of grading: numerical grade</li> <li>written examination (60 minutes)</li> </ul> </li> <li>Assessment in module component o8-CP1-3-072: General and Analytical Chemistry (lab) <ul> <li>2 ECTS, Method of grading: (not) successfully completed</li> <li>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)</li> <li>Assessment offered: once a year, summer semester</li> <li>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.</li> </ul></li></ul>					
Additio	nal info	ormation			
Referre	d to in	<b>LPO I</b> (examination regulations	s for teaching-degree progra	mmes)	
			uogroup progra	,	
I					

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# **Computer Science** (10 ECTS credits)

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Module title				Abbreviation	
Introdu	Introduction to Computer Science for Students of all Faculties 10-I-EIN-072-mo1				
Module	e coord	inator		Module offered by	
Dean o	fStudi	es Informatik (Computer	Science)	Institute of Comput	er 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	site to assessment: a site to assessment in the beginnin	academic requirements to be met g of the course.
Conten	ts		• •		
Founda bases,	ations c algorit	of computer science inclu hms and data structures,	ding representation of programming (Java).	of information and w	ebsites (HTML, XML, EBNF), data-
Intend	ed lear	ning outcomes			
The stu mation	idents a and w	are familiar with the fund ebsites (HTML, XML, EBN	amentals of compute F), databases, algorit	er science, e.g. in the hms and data struct	e areas of representation of infor- ures, programming in Java.
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Ger	rman)	
V + Ü +	Ü (no i	nformation on SWS (wee	kly contact hours) an	d course language a	vailable)
Metho module is	<b>d of ass</b> s creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether
a) writt or c) or	en exai al exan	mination (approx. 90 mir nination in groups (group	nutes) or b) oral exam ps of 2: 30 minutes, g	ination of one candi roups of 3: 40 minut	date each (approx. 20 minutes) es)
Allocation of places					
Additional information					
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)	

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#### **Numerical Mathematics**

(10 ECTS credits)

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Module title				Abbreviation		
Numer	Numerical Mathematics 1 10-M-NM1-072-m01					
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	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					
Solutio ons, in	on of sy terpola	stems of linear equations tion with polynomials, sp	s and curve fitting pro plines and trigonome	blems, nonlinear eq tric functions, nume	juations and systems of equati- rical integration.	
Intend	ed lear	ning outcomes				
The stu to prac	ıdent is tical pr	acquainted with the fun oblems and knows abou	damental concepts a t their typical fields o	nd methods in nume f application.	erical mathematics, applies them	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
V + Ü (I	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)	
Metho module is	<b>d of ass</b> s creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	it every semester, information on whether	
a) writt or c) or	en exa al exan	mination (90 minutes; us nination in groups (group	ually chosen) or b) o s of 2, 30 minutes)	ral examination of o	ne candidate each (20 minutes)	
Allocation of places						
Additional information						
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		

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Module title				Abbreviation	
Numeri	Numerical Mathematics 2 10-M-NM2-072-m01				
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Solutio nary di	n meth fferenti	ods and applications for al equations, boundary v	eigenvalue problems alue problems.	s, linear programmin	g, initial value problems for ordi-
Intende	ed lear	ning outcomes			
The stu about t and en	ident is heir ad gineeri	able to draw a distinctio vantages and limitations ng sciences and econom	n between the differe concerning the poss ics.	ent concepts of nume ibilities of application	erical mathematics and knows on in different fields of natural
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infoi	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
Metho module is	<b>d of ass</b> s creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
a) writt nation	en exai in grou	mination (90 minutes) or ps of 2 candidates (30 m	b) oral examination ( inutes)	of one candidate eac	ch (20 minutes) or c) oral exami-
Allocation of places					
Additional information					
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	

Module title Abbreviation				Abbreviation	
Program	Programming Course for Mathematics and other students 10-M-PRG-072-mo1				
Module	e coord	inator		Module offered by	
Dean of	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
3	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Basics matics.	of a mo	odern programming langu	lage (e. g. C or Fortra	n) taking into accour	nt the particular needs in mathe-
Intende	ed lear	ning outcomes			
The stu in math	dent is iematio	able to work independe cs.	ntly on small program	nming exercises and	standard programming problems
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
P (no in	Iformat	tion on SWS (weekly cont	act hours) and cours	e language available	2)
Methoo module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
project	in the	form of programming exe	rcises (expenditure c	of time as specified a	at the beginning of the course)
Allocat	ion of p	olaces			
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

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Module	e title				Abbreviation
Computeroriented Mathematics					10-M-COM-072-m01
Module	e coord	inator		Module offered by	
Dean o	fStudi	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
3	(not) s	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
rical co 10-M-Ll and int	mputa NA). Co	tion (e. g. Matlab) to sup mputer-based solution of alculus; visualisation of f	plement the basic mo f problems in linear a functions.	odules in analysis an Ilgebra, geometry, an	id linear algebra (10-M-ANA and nalysis, in particular differential
Intende	ed lear	ning outcomes			
The stu fields o	ident le of appli	earns the use of advanced cation to solve mathema	d modern mathemation tical problems.	cal software package	es, and is able to assess their
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
Method module is	<b>d of ass</b> creditab	<b>Sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	it every semester, information on whether
project	in the	form of programming exe	rcises (expenditure c	of time as specified a	at the beginning of the course)
Allocat	ion of p	olaces			
Additio	onal inf	ormation			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	



# **Thesis** (10 ECTS credits)

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Module title				Abbreviation		
Bachelor Thesis Physics					11-BA-P-072-m01	
Module	e coord	inator		Module offered by		
chairpe	erson o	f examination committee		Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Mostly and sci	indepe entific	ndent processing of an e aspects.	xperimental or theor	etical task of Physics	s according to known procedures	
Intende	ed lear	ning outcomes				
The stu cording	dents a g to kno	are able to independently own methods and scientif	v work on an experim fic aspects and to wri	ental or theoretical t te the Bachelor's the	ask from Physics, especially ac- esis.	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
no cou	rses as	signed				
Methoo module is	<b>d of ass</b> creditab	s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
written Langua	thesis ge of a	(approx. 25 pages) ssessment: German or Ei	nglish			
Allocation of places						
Additio	nal inf	ormation				
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)					
written Langua Allocat  Additio  Referre 	thesis ge of a ion of p nal info ed to in	(approx. 25 pages) ssessment: German or En places ormation LPO I (examination regulation:	nglish	mmes)		



### Subject-specific Key Skills

(14 ECTS credits)

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Module title Abbreviation			Abbreviation		
Measurements and Data Analysis					11-PFR-072-m01
Module	e coord	inator		Module offered by	
Managi	ing Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
2	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Types of viation,	of error, , distrit	error approximation and oution functions, signification	propagation, graphs ance tests, writing of	s, linear regression, a lab reports and publ	average values and standard de- ications.
Intende	ed learı	ning outcomes			
In this I mental	module work, e	e, the students acquire su error propagation and the	bject-specific transfe principles of statisti	erable skills. They ha	we knowledge of practical experi-
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
<b>Methoo</b> module is	<b>d of ass</b> creditab	s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
written	examiı	nation (approx. 120 minu	tes)		
Allocat	ion of p	olaces			
Additional information					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					

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Module title					Abbreviation
Computational Physics					11-A1-072-m01
Module	e coord	inator		Module offered by	
Manag and As	ing Dire trophys	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Introdu sical pr	ction to	០ two of the programminរ s with computer program	g languages relevant mes.	for students of Physi	ics and Engineering, solving phy-
Intende	ed lear	ning outcomes			
The stu skills ir	dents l 1 worki	have acquired the followi ng with computers, know	ng transferable skills ledge of algorithms t	: Basic knowledge o o solve numeric phy	f two programming languages, sical problems.
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V + Ü (r	no infor	mation on SWS (weekly	contact hours) and co	ourse language avail	able)
Method module is	<b>d of ass</b> creditab	<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether
written	exami	nation (approx. 120 minu	tes)		
Allocation of places					
Additio	nal inf	ormation			
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	

Module	Module title Abbreviation				
Electronics					11-A2-072-m01
Module	coord	inator		Module offered by	
Managi	ng 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	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Principl technol	les of p logy.	assive and active electro	nic components and	their application in	analogous and digital circuit
Intende	ed leari	ning outcomes			
The stu circuit t	dents l echno	nave knowledge of the pr logy.	actical setup of elect	ronic circuits from th	ne field of analogous and digital
Course	<b>S</b> (type, r	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V + Ü (r	no infor	mation on SWS (weekly o	contact hours) and co	ourse language avail	able)
<b>Methoc</b> module is	<b>l of ass</b> creditab	s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether
written	examiı	nation (approx. 90 minut	es)		
Allocation of places					
Additional information					
Referred to in LPO I (examination regulations for teaching-degree programmes)					

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Module title					Abbreviation
Laboratory and Measurement Technology			11-A3-072-m01		
Module	Module coordinator			Module offered by	
Manag	ing Dire	ector of the Institute of A <sub>l</sub>	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme Conten Introdu	Admission prerequisite to assessment: successful completion of a 50% of exercises. Certain prerequisites must be met to qualify for a sion to assessment. The lecturer will inform students about the res ve details at the beginning of the course. Registration for the course be considered a declaration of will to seek admission to assessment students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registrati assessment into effect. Students who meet all prerequisites will be mitted to assessment in the current or in the subsequent semester assessment at a later date, students will have to obtain the qualific for admission to assessment anew.		successful completion of approx. must be met to qualify for admis- orm students about the respecti- ex. Registration for the course will ek admission to assessment. If n for admission to assessment curer will put their registration for eet all prerequisites will be ad- n the subsequent semester. For I have to obtain the qualification		
Intende	ed lear	ning outcomes			
The stu cal met red vali	idents l trology, ue acqi	have acquired the follow , cryogenics and vacuum uisition.	ing transferable skills technology, cryogeni	: Electronic and opti cs, light sources, sp	ical measuring methods in physi- ectroscopic methods and measu-
Course	<b>S</b> (type, r	number of weekly contact hours,	anguage — if other than Ger	man)	
V + Ü (r	no infoi	rmation on SWS (weekly	contact hours) and co	ourse language avail	able)
Method module is	<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)				
written	written examination (approx. 120 minutes)				
Allocat	ion of <sub>l</sub>	olaces			
Only as	s part o	f pool of general key skil	ls (ASQ): 15 places. P	laces will be allocate	ed by lot.
Additional information					
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	

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Module title					Abbreviation
Astrophysics					11-A4-072-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Theoretical Physics and Astrophysics				Faculty of Physics and Astronomy	
ECTS Method of grading		Only after succ. compl. of module(s)			
6	nume	rical grade			
Duration		Module level	Other prerequisites		
1 semester u		undergraduate	Admission prerequisite to assessment: successful completion of approx. 50% of exercises. 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					
History of astronomy, coordinates and time measurement, the solar system, size scales in outer space, telesco- pes and detectors, stellar structure, stellar atmospheres, stellar evolution, final stages of stellar evolution, inter- stellar medium, structure of the Milky Way, local universe, expanding space-time, galaxies, active galactic nuclei, large-scale structure of the universe, Friedmann World Models, thermodynamics of the early universe, primordial nucleosynthesis, cosmic microwave background radiation, structure formation, inflation					
Intended learning outcomes					
The students are familiar with the modern world view of Astrophysics. They know methods and tools for astro- physical observations and evaluations. They are able to use these methods to plan and analyse own observati- ons. They know the structure of the universe, e.g. of stars and galaxies and understand the process of their deve- lopment.					
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)					
V + S (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)					
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					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					