

Module Catalogue

for the Subject

Mathematical Physics

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

Examination regulations version: 2016 Responsible: Faculty of Mathematics and Computer Science Responsible: Institute of Mathematics Responsible: Faculty of Physics and Astronomy

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Julius-Maximilians-UNIVERSITÄT WÜRZBURG

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Learning Outcomes

German contents and learning outcome available but not translated yet.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen sind vertraut mit den Arbeitsweisen und der zugehörigen Fachsprache der Mathematik und beherrschen die Methoden mathematischen Denkens und Beweisens.
- Die Absolventinnen und Absolventen besitzen Kenntnisse mathematischer Grundlagen der Theoretischen Physik und sind vertraut mit den grundlegenden Beweismethoden dieser Gebiete.
- Die Absolventinnen und Absolventen verstehen die mathematischen, theoretischen und experimentellen Grundlagen der Physik und können diese anwenden.
- Die Absolventinnen und Absolventen können unter Anleitung Experimente durchführen, analysieren und die erhaltenen Ergebnisse darstellen und bewerten.
- Die Absolventinnen und Absolventen sind in der Lage, physikalische Probleme durch Anwendung der wissenschaftlichen Arbeitsweise und unter Beachtung der Regeln guter wissenschaftlicher Praxis (Dokumentation, Fehleranalyse) zu bearbeiten.
- Die Absolventinnen und Absolventen verstehen die wesentlichen Zusammenhänge und Konzepte der einzelnen Teilgebiete der Theoretischen Physik.
- Die Absolventinnen und Absolventen sind in der Lage, ihre mathematischen Fähigkeiten auf physikalische Fragestellungen anzuwenden.
- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, sich selbständig mithilfe von Fachliteratur in weitere Gebiete der Mathematik und Physik einzuarbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen verständlich zu präsentieren.
- Die Absolventinnen und Absolventen besitzen die für ein weiterführendes, insbesondere Master-Studium in Mathematik und Physik, erforderlichen Grundkenntnisse, Denk- und Arbeitsweisen und Methodenkenntnisse.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie in ihrer eigenen Arbeit zu beachten.

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen zielgruppenorientiert verständlich, auch in einer Fremdsprache zu formulieren und zu präsentieren.
- Die Absolventinnen und Absolventen sind in der Lage, konkrete Probleme zu erkennen, strukturieren und modellieren und mit mathematischen und physikalischen Methoden Lösungswege zu entwickeln.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, sich weitere Wissensgebiete selbständig, effizient und systematisch zu erschließen.
- Die Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in einem heterogenen, interdisziplinären Team zusammenzuarbeiten, unterschiedliche und abweichen-

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de Ansichten produktiv zur Zielerreichung zu nutzen und auftretende Konflikte zu lösen (Teamfähigkeit).

• Die Absolventinnen und Absolventen sind in der Lage, Daten mit Hilfe von statistischen Methoden zu analysieren, zu interpretieren und darzustellen.

Persönlichkeitsentwicklung

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- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie in ihrer eigenen Arbeit zu beachten.
- Die Absolventinnen und Absolventen sind in der Lage, gesellschaftliche, wirtschaftliche und historische Entwicklungen und Prozesse kritisch zu reflektieren und zu bewerten.
- Die Absolventinnen und Absolventen entwickeln die Bereitschaft und Fähigkeit, ihre Kompetenzen in partizipative Prozesse einzubringen und aktiv an Entscheidungen mitzuwirken.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, Ideen und Lösungsvorschläge allgemeinverständlich zu formulieren und präsentieren.

Abbreviations used

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

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

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

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

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

Conventions

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

Notes

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

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

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

In accordance with

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

ASPO2015

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

27-Jul-2016 (2016-91)

12-Jun-2024 (2024-74)

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.

Bachelor's with 1 major Mathematical Physics	
(2016)	



Compulsory Courses

(110 ECTS credits)



Subfield Analysis

(27 ECTS credits)

Analysis J 10-M-ANA1:152-m01 Module correlation of Studies Mathematik (Mathematics) Institute of Mathematics Dear of Studies Mathematik (Mathematics) Institute of Mathematics CRTS Method of grading Only after succ. comp Let Mathematics Duration Module letevt Other prerequisites Image: Comparison of Studies (Mathematics) Duration Module feed Other prerequisites (Mathematics) Image: Comparison of Studies (Mathematics) Contents undergraduate	Module title				Abbreviation	
Dean of Studies Mathematik (Mathematics) Institute of Mathematics ECTS Method of grading Only after succ. compl. of module(s) 8 (not) successfully completed Duration Module level Other prerequisites 1 semester Undergraduate Contents Real numbers and completeness; basics topological notions; convergence and divergence of sequences and series; power series and Taylor series; basics in differential calculus in one variable; basics of integral calculus in one variable; basics of methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form. Courses (type, number of weekly contact hours, language – if other than German; V(4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for borus) Language of assessment (type, scope, language – if other than German; examination offered – if not every semester, information on the places	Analysis 1					10-M-ANA1-152-m01
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Duration Module level Other prerequisites 1 semester undergraduate Contents Real numbers and completeness; basics in differential calculus in one variable; basics of integral calculus in one variable; Riemann integral and improper integral). Intended learning outcomes The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each) Language of assessment: German and/or English Allocation of places Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Automatics (2015) Bachelor's degree (1 major) Conomathematics (2015) Bachelor's degree (1 major) Conomathematics (2015)	ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
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Language of assessment: German and/or English Allocation of places				minutes) and writter	n exercises (approx.	12 exercise sheets with approx. 4
Allocation of places Additional information Workload 240 h Teaching cycle Referred to in LPO 1 (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2013) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematic			,	or English		
Additional information Additional Mathematics (2015) Bachelor's degree (1 major) Mathematics (2017) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2013) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2013) Bachelor's degree (1 major) Economathematics (2017) Bache						
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Workload 240 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Economathematics (2015) Bachelor's degree (1 major) Omputational Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Deconomathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Deconomathematics (2017) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)						
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240 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Economathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)						
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Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Economathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Economathematics (2016) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)	240 h					
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Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Economathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)						
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Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Economathematics (2017) Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)						
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Bachelor's degree (1 major) Economathematics (2021) exchange program Mathematics (2023)						
exchange program Mathematics (2023)						
Bachelor's degree (1 major) Mathematics (2023)						
	Bachel	or's deg	gree (1 major) Mathemati	cs (2023)		

Modul	Module title Abbreviation					
Overview Analysis for Mathematical Physics 10-M-ANP-Ü-152-mo1					10-M-ANP-Ü-152-m01	
Module coordinator Module offe					1	
Dean o	of Studio	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
12	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conter	Its					
ries, di	fferenti		n one variable, furthe		livergence of sequences and se- derations, differential calculus	
Intend	ed lear	ning outcomes				
lytic ba ten and	ckgrou d oral fo	nd and geometric interpr orm.	retation, and can inte	rconnect them and o	d concepts of analysis, their ana- express them adequately in writ-	
		number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if n	ot every semester, information on whether	
Assess	ment w	ion of one candidate eac vill have reference to the ssessment: German and	contents of modules	10-M-ANA-1 and 10-	M-ANP-Ü.	
	ion of p		<u>_</u>			
Additio	onal inf	ormation				
Worklo	ad					
360 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
	e appea					
		gree (1 major) Mathemati	,			
Bachel	Bachelor's degree (1 major) Mathematical Physics (2016)					

Module title				Abbreviation	
Advanced Analysis 10-M-VAN-152-m01					10-M-VAN-152-m01
Module coordinator Mod			Module offered by		
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
7	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Continu	uation o	of analysis in several vari	ables, integration the	eorems.	
		ning outcomes			
The stu	dent is				of the Lesbegue integral, he or
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
Method	l of ass	s essment (type, scope, langua; le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
b) oral (c) oral (examin examin ge of a	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or	
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
210 h					
Teachir	ng cycl	6			
	0.,	-			
Referre	d to in	LPO I (examination regulations	s for teaching-degree program	mmes)	
Module	annea	urs in			
Module appears in Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015)					
		gree (1 major) Mathemati		015)	
Bachelor's degree (1 major) Mathematical Physics (2016)					
Master's degree (1 major) Physics (2016)					
	Master's degree (1 major) Nanostructure Technology (2016)				
	Master's degree (1 major) Nanostructure Technology (2020)				
	Master's degree (1 major) Physics (2020)				
	Master's degree (1 major) Physics International (2020)				
	Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021)				
	-	gree (1 major) Quantum rec gree (1 major) Mathemati			



Subfield Linear Algebra

(20 ECTS credits)

Module title				Abbreviation	
Linear Algebra 1					10-M-LNA1-152-m01
Module coordinator				Module offered by	
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
8	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Basic n termina		and structures; vector sp	aces, linear maps, sy	stems of linear equa	ations; theory of matrices and de-
Intende	ed leari	ning outcomes			
ted witl	h the ce	entral proof methods in li	near algebra and can	apply them to solve	ear algebra. He/She is acquain- e easy problems. He/She is able m adequately in written form.
Course	S (type, n	number of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
exercis	es eacl			n exercises (approx.	12 exercise sheets with approx. 4
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
240 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module appears in					
Bachelor's degree (1 major) Mathematics (2015)					
Bachelor's degree (1 major) Economathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015)					
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015)					
	Bachelor's degree (1 major) Mathematical Physics (2016)				
Bachelor's degree (1 major) Economathematics (2017)					
Bachel	Bachelor's degree (1 major) Economathematics (2021)				
	exchange program Mathematics (2023)				
Bachel	or's de	gree (1 major) Mathemati	cs (2023)		

Modul	Module title Abbreviation					
Overvi	Overview Linear Algebra for Mathematical Physics 10-M-LNP-Ü-152-m01					
Module coordinator Module offered by					<u> </u>	
Dean o	of Studio	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
12	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conter	Its					
determ		eigenvalue theory; bilin			equations; theory of matrices and paces; diagonalisability and Jor-	
Intend	ed lear	ning outcomes				
knows them a	about t dequat	heir algebraic and geomely in written and oral for	etric background, is a m.	ble to relate them to	and methods of linear algebra, o each other and can present	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
Assess	ment w	ion of one candidate eac vill have reference to the ssessment: German and	contents of modules	10-M-LNA-1 and 10- <i>1</i>	M-LNP-Ü.	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
360 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Modul	Module appears in					
	Bachelor's degree (1 major) Mathematical Physics (2015)					
Bachelor's degree (1 major) Mathematical Physics (2016)						



Subfield Classical Physics

(16 ECTS credits)

Module coordination Managing Direct ECTS Method 8 numeric Duration N 1 semester u Contents 1. Principles: Phr 1. Principles: Phr finition, measure 2. Point Mechan motion, free fall,	tor of the Institute of Ap of grading cal grade Module level indergraduate ysical quantities, preface rement procedures, SI),	Only after succ. com Other prerequisites Admission prerequisites 13 exercise sheets p approx. 50% of exer lecturer will inform so of the semester.	site to assessment: o er semester). Stude cises will qualify for	11-E-M-152-mo1 and Astronomy completion of exercises (approx. nts who successfully completed admission to assessment. The espective details at the beginning
Managing Direct ECTS Method 8 numeric Duration N 1 semester u Contents 1. Principles: Phr finition, measure 2. Point Mechan motion, free fall,	tor of the Institute of Ap of grading cal grade Module level indergraduate ysical quantities, preface rement procedures, SI),	Only after succ. com Other prerequisites Admission prerequisites 13 exercise sheets p approx. 50% of exer lecturer will inform so of the semester.	Faculty of Physics a pl. of module(s) site to assessment: of er semester). Stude cises will qualify for	completion of exercises (approx. nts who successfully completed admission to assessment. The
ECTS Method 8 numeric Duration N 1 semester u Contents 1. Principles: Phy finition, measure 2. Point Mechan motion, free fall,	of grading cal grade Aodule level indergraduate ysical quantities, preface rement procedures, SI),	Only after succ. com Other prerequisites Admission prerequisites 13 exercise sheets p approx. 50% of exer lecturer will inform so of the semester.	site to assessment: er semester). Stude cises will qualify for	completion of exercises (approx. nts who successfully completed admission to assessment. The
8 numeric Duration N 1 semester u Contents 1. Principles: Phr finition, measure 2. Point Mechan motion, free fall,	al grade Aodule level Indergraduate ysical quantities, preface rement procedures, SI),	 Other prerequisites Admission prerequisites 13 exercise sheets p approx. 50% of exer lecturer will inform s of the semester.	site to assessment: o er semester). Stude cises will qualify for	nts who successfully completed admission to assessment. The
8 numeric Duration N 1 semester u Contents 1. Principles: Phr finition, measure 2. Point Mechan motion, free fall,	al grade Aodule level Indergraduate ysical quantities, preface rement procedures, SI),	 Other prerequisites Admission prerequisites 13 exercise sheets p approx. 50% of exer lecturer will inform s of the semester.	site to assessment: o er semester). Stude cises will qualify for	nts who successfully completed admission to assessment. The
Duration N 1 semester u 1 semester u Contents u 1. Principles: Phrinition, measure u 2. Point Mechan motion, free fall,	Aodule level Indergraduate ysical quantities, preface rement procedures, SI),	Admission prerequis 13 exercise sheets p approx. 50% of exer lecturer will inform s of the semester.	site to assessment: er semester). Stude cises will qualify for	nts who successfully completed admission to assessment. The
1 semester u Contents 1. Principles: Phy finition, measure 2. Point Mechan motion, free fall,	ndergraduate ysical quantities, prefa	Admission prerequis 13 exercise sheets p approx. 50% of exer lecturer will inform s of the semester.	site to assessment: er semester). Stude cises will qualify for	nts who successfully completed admission to assessment. The
1. Principles: Ph finition, measure 2. Point Mechan motion, free fall,	ement procedures, SI),	ctors, derived quanti		
finition, measure 2. Point Mechan motion, free fall	ement procedures, SI),	ctors, derived quanti		
mic scale, isotro 4. Work and ene 5. Elastic, inelas and balance sys 6. Conservative and potential of 7. Rotational mo gies to linear tra in the central po 8. Tidal forces: I gal force; 9. Galilean trans postulates, prob pulse; 10. Rigid body a their stability, te tation, the Earth 11. Friction: Stati mation; 12. Vibration: Re power approach vibration (resona 13. Coupled vibr non-linear dynau 14. Waves: Wave at the open and relation; 15. Elastic deform 16. Fluids: Hydro	, slate litter; circular mo s: Forces and momentu opic and anisotropic fric ergy: (Kinetic) performan stic and super-elastic co stem, rocket equation; and non-conservative fr gravity (general relation otion: Angular momentu anslation, applications, otential; nertial system, reference sformation: Brief digress olem of simultaneity, Lo and gyroscope: Determinensor on the example of a sa a spinning top; ic and dynamic friction, epresentation by means n, Taylor expansion, har ant case, Kriechfall, apor rations: Eigenvalues and mics and chaos; e equation, transverse a closed end, speed of si mation of solid bodies: ostatic pressure and bu	n in 2D and 3D / vector of in polar coordin im definition, weight ction. Preparation of the nee, examples; ollision: Energy and n force fields: Potential ns); um, angular velocity, satellites (geostation ce systems, apparent sion to Maxwell's equipmentz transformation ning the centre of ma f the elasticity tensor , stick-slip motion, ro s of complex e-function eriodic limit), forced d eigenfunctions, do and longitudinal wav ound; interference, D Elastic modulus, ger oyancy, surface tens	ors, special cases: Unates; vs. mass forces on t the equations of more nomentum conserva , potential energy; la torque, rotational er nary and interstellar) forces, Foucault per uations, ether, Mich , time dilation and lo ss, inertia tensor an , physics of the bike offing friction, viscou on, equation of moti n; spring and pendul vibration, Fourier an uble pendulum, dete es, polarisation, prir oppler effect; phase heral Hooke's law, ef-	tion, surges in centre of mass aw, weight scale, field strength hergy, moment of inertia, analo-), escape velocities, trajectories ndulum, Coriolis force, centrifu- elson interferometer, Einstein's ength contraction, relativistic im- d -ellipsoid, principal axes and r; gyroscope: Precession and nu- s friction, laminar flow, eddy for- on (DGL) on forces, torque and lum, physical pendulum, damped alysis; erministic vs. chaotic motion, nciple of superposition, reflection e and group velocity, dispersion

Bachelor's with 1 major Mathematical Physics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. da-
(2016)	ta record Bachelor (180 ECTS) Mathematische Physik - 2016

Intended learning outcomes

The students understand the basic contexts and principles of mechanics, vibration, waves and kinetic theory of gases. 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.

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

V (4) + Ü (2)

Module taught in: Ü: German or English

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)

Language of assessment: German and/or English

Allocation of places

Additional information

Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student's registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment was not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.

Workload

240 h

Teaching cycle

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

§ 53 | Nr. 1 a) § 77 | Nr. 1 a)

Module appears in

module appears in				
Bachelor's degree (1 major) Physics ((2015)			
Bachelor's degree (1 major) Nanostru	icture Technology (2015)			
Bachelor's degree (1 major) Mathematical Physics (2015)				
Bachelor's degree (1 major, 1 minor) I	Physics (Minor, 2015)			
First state examination for the teaching	ng degree Grundschule Physics (2015)			
First state examination for the teaching	ng degree Realschule Physics (2015)			
First state examination for the teaching	ng degree Gymnasium Physics (2015)			
First state examination for the teaching	ng degree Mittelschule Physics (2015)			
Bachelor's degree (1 major) Mathema	atical Physics (2016)			
First state examination for the teaching degree Grundschule Physics (2018)				
First state examination for the teaching degree Realschule Physics (2018)				
First state examination for the teaching degree Gymnasium Physics (2018)				
First state examination for the teaching degree Mittelschule Physics (2018)				
Bachelor's degree (1 major) Physics (2020)				
Bachelor's degree (1 major) Nanostru	Bachelor's degree (1 major) Nanostructure Technology (2020)			
Bachelor's degree (1 major) Mathema	atical Physics (2020)			
Bachelor's degree (1 major, 1 minor) I	Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020)			
First state examination for the teaching degree Grundschule Physics (2020)				
First state examination for the teaching degree Gymnasium Physics (2020)				
First state examination for the teaching	ng degree Realschule Physics (2020)			
Bachelor's with 1 major Mathematical Physics (2016)	JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- ta record Bachelor (180 ECTS) Mathematische Physik - 2016	page 19 / 147		

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

First state examination for the teaching degree Mittelschule Physics (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Quantum Technology (2021) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Functional Materials (2025)

Module	title			,	Abbreviation	
Classic	al Phys	ics 2 (Heat and Electro	magnetism)		11-E-E-152-m01	
Module	coord	inator		Module offered by	<u>I</u>	
Managing Director of the Institute of Applied Physics Fac			Faculty of Physics a	Faculty of Physics and Astronomy		
ECTS Method of grading Only after succ. compl. of module(s)						
8	1	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semester undergraduate			Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.			
Conten	ts					
2. Heat 3. Fund 4. Heat 5. Real phenom 6. Elect point cl 7. Gaus cial syn 8. Elect equipol lace eff 9. Matte on, thei 10. Cap dia in the ectric d 11. Elec 12. Resi ohmic, 13. Circ suring i 14. Pow 15. Tran 16. Mag gnetic f 17. Vect Helmho 18. Mov pole fie 19. mat ferroma 20. inducta 21. Max equato 22. AC: stance;	condu amenta engine gases a nena (c rostation narge; sian se metrical po- tential ects, S er in th rmionica acitor, he capa isplace tricity, istance NTC, P uits, el nstrum ver and usfer m gnetost ield; Au tor pote oltz coil ving cha tor pote oltz coil suction, nce, se construction son; Maxa Capac	ectrical networks, Kirch lents; Wheatstone bridg energy in the circuit; C echanisms, conduction atics, fundamental law mper's Law, analogous ential, formal derivation	Tusion, convection, rac ynamics, entropy, irrev fficiency, example: Sti atter (also solids), van ice region, Joule-Thom etrical charge, forces; e omb's law, definition in differential form; E-box, electric. potent tant examples: Sphere mogeneous field, Mill mogeneous and inhor n, capacity; plate and ation, displacement an citor; Piezoelectric effi- ensity, drift velocity, co stivity, temperature de hoff's rules (meshes, n ge; apacitor charge; galva in solids: Band mode s; permanent magnet, to e-box, magn. river, n, analogous to electric etic field, current balar ectrometer, Wien filter ts of the field on matter e electron, behaviour cion, Lenz's rule, flux c ns: Transformer, gener choice of integration an rations, amplitude, peo pr, capacitor and coil, p	liant heat; versibility, Maxwell's rling engine; der Waals, critical p son; electric field, reps. fi of "river"; Gaussian ial, potential differen e, hollow sphere, ca ikan experiment, Bra nogeneous field; ind spherical capacitor; nd orientation polari ect; onduction mechanisi pendence; Ohm's la nodes); internal resi nic element; thermo l, semiconductor; lir field properties, def swirl; c scalar potential; ca nce, Lorentz force, rig s, Hall effect; electro er, relative permeabi at interfaces; hange, eddy electric rator; rea, displacement cu	s demon; point, phase transition eld concept, field line surface, divergence to nace, voltage; potention pacitor plates, electron duction, Faraday cage combination of capa isation, microscopic ms; w; realisations (resist stance of a voltage so voltage; he in liquids and gase initions and units; Ea ellculation of fields, es ght-hand rule, electrion: e / m determination lity, susceptibility; po field, Waltenhofen's urrent; Maxwell's externed ver and RMS value, o	ons, critical es, field of a cheorem; spe- al equation, ic dipole; ield emissi- e; acitors; me- image; diel- stive and non- ource, mea- es; arth's ma- xamples, ic motor; di- ion; ara-, dia-, s pendulum; ension, wave
-		or Mathematical Physics		generated 19-Apr-2025 • ex	am rag da	nago 21 / 11-
achelor's v 2016)	witii 1 maj	or mathematical Physics		r (180 ECTS) Mathematische		page 21 / 147

23. Resonant circuits, combinations of RLC; series and parallel resonant circuit; forced vibration, damped harmonic oscillator (related to 11-E-M);

24: Hertz dipole, characteristics of irradiation, near field, far field; Rayleigh scattering; accelerated charge, synchrotron radiation, X-rays; 25. Electromagnetic waves: Principles, Maxwell's determination to electromagnetism, radiation pressure (Poynting vector, radiation pressure).

Intended learning outcomes

The students understand the basic principles and contexts of thermodynamics, science of electricity and magnetism. They know relevant experiments to observe and measure these principles and contexts. 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)

V (4) + Ü (2)

Module taught in: Ü: German or English

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) Language of assessment: German and/or English

Allocation of places

Additional information

Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student's registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment to whose not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.

Workload

240 h

Teaching cycle

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

§ 53 l Nr. 1 a)

§ 77 | Nr. 1 a)

Module appears in

Bachelor's degree (1 major) Physics (2015) Bachelor's degree (1 major) Nanostructure Technology (2015) Bachelor's degree (1 major, 1 minor) Physics (2015) First state examination for the teaching degree Grundschule Physics (2015) First state examination for the teaching degree Realschule Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Mittelschule Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) First state examination for the teaching degree Grundschule Physics (2018) First state examination for the teaching degree Realschule Physics (2018) First state examination for the teaching degree Gymnasium Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018) First state examination for the teaching degree Gymnasium Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018)

Bachelor's with 1 major Mathematical Physics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. da-	page 22 / 147
(2016)	ta record Bachelor (180 ECTS) Mathematische Physik - 2016	

Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) First state examination for the teaching degree Grundschule Physics (2020) First state examination for the teaching degree Gymnasium Physics (2020) First state examination for the teaching degree Realschule Physics (2020) First state examination for the teaching degree Mittelschule Physics (2020) First state examination for the teaching degree Mittelschule Physics (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Quantum Technology (2021) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Functional Materials (2025)



Subfield Theoretical Mechanics and Quantum Mechanics

(16 ECTS credits)

Module title			Abbreviation					
Theoret	tical M	echanics			11-T-MV-162-m01			
Module	coord	inator		Module offered by				
Managi and Ast		ector of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy			
ECTS Method of grading Only after succ. compl. of module(s)								
5	nume	rical grade						
Duratio	n	Module level	Other prerequisites					
1 semes	ster	undergraduate						
Conten	Contents							
on, ene 2. Lagra ons, me system 3. Hami Poissor Liouville 4. Appli electror ring, cro 5. Relat 6. Non- Intende The stu miliar w	 Newton's formulation: Inertial systems, Newton's laws of motion, equations of motion; one-dimensional motion, energy conservation; Harmonic oscillator; Movement in space of intuition, conservative forces; Lagrangian formulation: Variational principles, Euler-Lagrange equation; constraints; coordinate transformations, mechanical gauge transformation; symmetries, Noether theorem, cyclic coordinates; accelerated reference systems and apparent forces; Hamiltonian formulation: Legendre transformation, phase space; Hamilton function, canonical equations; Poisson brackets, canonical transformations; generator of symmetries, conservation laws; minimal coupling; Liouville theorem; Hamilton-Jacobi formulation [optional]; Applications: Central-force problems; mechanical similarity, Virial theorem; minor vibrations; particles in an electromagnetic field; rigid bodies, torque and inertia tensor, centrifugal and Euler equations [optional]; scattering, cross section [optional]; Relativistic dynamics: Lorentz Transformation; Minkowski space; equations of motion; Non-linear dynamics: Stability theory; KAM theory [optional]; deterministic chaos [optional] Intended learning outcomes The students have gained first experiences concerning the working methods of Theoretical Physics. They are familiar with the principles of theoretical mechanics and their different formulations. They are able to independently apply the acquired mathematical methods and techniques to simple problems of Theoretical Physics and 							
Course	5 (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)				
V (4)								
		e ssment (type, scope, langua) le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether			
		nation (approx. 120 minu ssessment: German and/						
Allocati	<u> </u>		0. 23					
	•							
Additio	nal info	ormation						
Worklo	ad							
150 h								
Teachir	ng cycl	9						
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)				
Module								
Bachelo	or's des	gree (1 major) Mathemati	cal Physics (2016)					

Module	title				Abbreviation		
Quantu	m Mec	hanics			11-T-QV-162-m01		
Module	coord	inator		Module offered by			
Managi and Ast		ector of the Institute of T sics	heoretical Physics	Faculty of Physics a	nd Astronomy		
ECTS	Metho	od of grading	Only after succ. con	Only after succ. compl. of module(s)			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites	;			
1 seme	ster	undergraduate					
Conten	ts						
quantu 2. Wave pulse m tionary 3. Form space a 4. Postu certaint 5. One- try prop 6. Spin- two-lev 7. Angu solution 8. Centi 9. Motio Gauge to of a free 10. Spin 11. Add 12. App time-de 13. Ator	m mecle functione solutione alisation alisatione alisatione alisatione alisatione alisatione perties; -1/2 system alisatione perties; -1/2 system alisatione alisatio	basics: Limits of classic hanics (QM); on and Schrödinger equ ement; correspondence ons of SG on of QM: Eigenvalue ec ac notation; representat of QM (and their interpre- sional problems: The ha stems I: Theoretical des ems (qubits); mentum: Commutation e eigenvalue equation ir ential - hydrogen atom: n electromagnetic field: rmation; Aharonov-Boh on in a magnetic field; ystems II: Formulation u fangular momenta: tion methods: Stationa nt perturbation theory; n several electrons: Ider and Hund's rules	aation (SG): SG for free principles: postulates uations; Physical sign ions in state space; to etation): State; measu rmonic oscillator; pot cription in Dirac notat and rotations; eigenva polar coordinates (co Bonding states in 3D; Hamiltonian; Normal m effect; Schrödinger sing angular moment ry perturbation theory	e particles; superpos s of QM; Ehrenfest the nificance of the eigen ensor products of sta trement; chronologic ential level; potentia tion; Spin 1/2 in the h alues of the angular of porcrete); Coulomb potential; Zeeman effect; cano , Heisenberg and inte um algebra; (with examples); van	ition; probability dis eorem; continuity eo ivalues of an operato ite spaces; al development; ene l barrier; potential w nomogeneous magn momentum operator enical and kinetic mo eraction representation	stribution for quation; sta- or; state ergy-time un- vell; symme- etic field; rs (abstract); omentum; ion; motion KB method;	
Intende	Intended learning outcomes						
The students have gained first experiences concerning the working methods of Theoretical Physics. They are fa- miliar with the principles of quantum theory. They are able to apply the acquired mathematical methods and techniques to simple problems of quantum theory and to interpret the results. They have especially acquired knowledge of advanced mathematical concepts.							
Course	S (type, n	umber of weekly contact hours	language — if other than Ge	rman)			
V (4)							
		e essment (type, scope, langule for bonus)	age — if other than German,	examination offered — if no	t every semester, informat	ion on whether	
	written examination (approx. 120 minutes) Language of assessment: German and/or English						
Allocat	-						
Additio	nal inf	ormation					
Bachelor's (2016)	with 1 maj	or Mathematical Physics	-	• generated 19-Apr-2025 • exa or (180 ECTS) Mathematische	-	page 26 / 147	

Workload

150 h

Teaching cycle

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

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Module appears in

Bachelor's degree (1 major) Mathematical Physics (2016)

Bachelor's with 1 major Mathematical Physics
(2016)

				Abbreviation
neoretical Me	chanics and Quantum M	Aechanics - Excercise	25	11-T-TMQ-162-m01
Aodule coordii	nator		Module offered by	
Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronor		and Astronomy		
and Astrophysi	CS	F		
ECTS Method of grading Only after succ. compl. of module(s)				
<u> </u>	uccessfully completed			
Duration	Module level	Other prerequisites	i	
semester	undergraduate			
Contents				
ninor vibration er equations (c cowski space; haos (optiona stulates of QM,	es; particles in an electro optional]; scattering, cro equations of motion, no l], wave function and Sc dimensional problems electromagnetic field, ac	omagnetic field; rigid oss section [optional] on-linear dynamics, si chrödinger equation (, spin-1/2 systems, a	bodies, torque and , relativistic dynami tability theory; KAM (SG), formalisation c ngular momentum,	anical similarity, Virial theorem; inertia tensor, centrifugal and Eu cs, Lorentz transformation; Min- theory [optional]; deterministic of QM, eigenvalue equations, po- central potential, hydrogen atom on methods, atoms with several
	-	·		
niliar with the quantum mech o simple probl	principles of theoretical anics. They are able to i	mechanics, their dif ndependently apply sics, to interpret the r	ferent formulations the acquired mathe	Theoretical Physics. They are fa- and the mathematical methods of matical methods and techniques
•	is of quantum theory. Th interpret the results in	, , ,		them to the description and solu of basic mathematical concepts
and are able to	. ,	a physical manner.	cquired knowledge	them to the description and solu
and are able to Courses (type, nu U (2) + Ü (2)	interpret the results in	a physical manner.	cquired knowledge	them to the description and solu
nd are able to Courses (type, nu J (2) + Ü (2) Aodule taught	interpret the results in a mber of weekly contact hours, lin: German or English	a physical manner. anguage — if other than Ger	cquired knowledge	them to the description and solu
Ind are able to Courses (type, nu J (2) + Ü (2) Module taught Method of asse nodule is creditable Students must To pass the asse nform students	interpret the results in mber of weekly contact hours, l in: German or English essment (type, scope, langua for bonus) complete approx. 13 exe	a physical manner. anguage — if other than Ger ge — if other than German, ercise sheets per sen st successfully compl letails at the beginnin	cquired knowledge man) examination offered — if n nester. ete approx. 50% of	them to the description and solu of basic mathematical concepts
Ind are able to Courses (type, nu J (2) + Ü (2) Module taught Method of asse nodule is creditable Students must To pass the asse nform students	interpret the results in mber of weekly contact hours, l in: German or English essment (type, scope, langua for bonus) complete approx. 13 exp sessment, students mus s about the respective d sessment: German and	a physical manner. anguage — if other than Ger ge — if other than German, ercise sheets per sen st successfully compl letails at the beginnin	cquired knowledge man) examination offered — if n nester. ete approx. 50% of	them to the description and solu of basic mathematical concepts ot every semester, information on whether
and are able to Courses (type, nu) (2) + Ü (2) Module taught Method of asse nodule is creditable Students must o pass the ass nform students anguage of as	interpret the results in mber of weekly contact hours, l in: German or English essment (type, scope, langua for bonus) complete approx. 13 exp sessment, students mus s about the respective d sessment: German and	a physical manner. anguage — if other than Ger ge — if other than German, ercise sheets per sen st successfully compl letails at the beginnin	cquired knowledge man) examination offered — if n nester. ete approx. 50% of	them to the description and solu of basic mathematical concepts ot every semester, information on whether

Workload

180 h

Teaching cycle

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

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Module appears in

Bachelor's degree (1 major) Mathematical Physics (2016)

Bachelor's with 1 major Mathematical Physics
(2016)



Subfield Statistical Physics and Electrodynamics I

(6 ECTS credits)

Module	title				Abbreviation		
Statisti	ical Ph	ysics and Electrodynamic	CS		11-T-SE-152-m01		
Module	e coord	inator		Module offered by			
Managi and Ast	-	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	ind Astronomy		
			Only after succ. con	npl. of module(s)			
6	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
2 seme	ster	undergraduate					
Conten	Contents						
cro-stat 1. Statis closed 2. Ideal 3. Statis ralised 4. Thern thermo 5. Ideal se-Eins 6. Syste ter simu 1 and 2 7. Critic BCS su o); prob	tes; pro stical P and op l syster stical F forces modyn dynam Syster tein co ems of ulation dimen cal phe percon olems o	bability space (condition hysics: Entropy and prob- ien systems (with energy ns: Spin systems; linear Physics and thermodynam the second and third law amics: Thermodynamic fu- ic machines (Carnot engi ns II, quantum statistics: ndensation; grids and no interacting particles: App (Monte Carlo method); in sions); Yang-Lee-theorer nomena: Scaling laws, cr ductivity); magnetism (qu of the thermodynamic lim	hal probability, statis bability theory; entrop and / or particle exch oscillators; ideal gas nics: The 1st law; qua w; reversibility; transi undamentals relation ne and efficiency); ch Systems of identical ormal modes: Phonor proximation methods nteracting phonons (ns; Van der Waals eq itical slowing down, fu uantum criticality at l nit;	tical independence) by in classical physic nange); si-static processes; tion from Statistical ship; thermodynami nemical potential; particles; ideal Fern S; (mean-field theory, Debye approximation uation for real intera fast variable as Bad ow temperatures, qu	s; thermodynamic equilibrium in entropy and temperature; gene- Physics to thermodynamics; ic potentials; changes of state; ni gas; ideal Bose gas and Bo- Sommerfeld expansion); compu- n); Ising models (particularities in acting gases; (electron-phonon interaction and uantum phase transitions at T =		
tence; I 1. Maxw 2. Elect multipo ment ac 3. Magr analogi 4. Maxw 5. Dyna waves; on; tem 6. Spec effect, e 7. Cova ler effec Intende	 B. Electrodynamics; o. Mathematical tools: Gradient, divergence, curl; curve, surface, volume integrals; Stokes and Gaussian sentence; Delta function; Fourier transform; full functional systems; solving PDEs; 1. Maxwell equations; 2. Electrostatics: Coulomb's law; electrostatic potential; charged interface; electrostatic field energy (capacitor); multipole expansion; Boundary value problems; numerical solution; Image charges; Green's functions; development according to orthogonal functions; 3. Magnetostatics: Current density; continuity equation; vector potential; Biot-Savart law; magnetic moment; analogies to electrostatics; 4. Maxwell equations in matter: Electrical and magnetic susceptibility; interfaces; 5. Dynamics of electromagnetic fields: Faraday induction; RCL-circuits; field energy and pulse; potentials; plane waves; wave packets; plane waves in matter; cavity resonators and wave guides; inhomogeneous wave equation; temporally oscillating sources and dipole radiation; accelerated point charges; 6. Special Theory of Relativity: Lorentz transform; simultaneity; length contraction and time dilation; light cone; effect, energy and momentum; co- and contra-variant tensors; covariant classical mechanics; 7. Covariant electrodynamics: Field strength tensor and Maxwell's equations; transformation of the fields; Doppler effect; Lorentz force 						
		thermodynamics and stat ttribute them to bigger p		iey are able to discu	ss the acquired theoretical con-		
		number of weekly contact hours, l		man)			
V (4) + V	V(4) + V(4)						

Bachelor's with 1 major Mathematical Physics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. da-	page 31 / 147
(2016)	ta record Bachelor (180 ECTS) Mathematische Physik - 2016	

UNIVERSITÄT WÜRZBURG

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

oral examination of one candidate each (approx. 30 minutes) Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload 180 h

Teaching cycle

--

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

Module appears in

Bachelor's degree (1 major) Physics (2015)

Bachelor's degree (1 major) Mathematical Physics (2015)

Bachelor's degree (1 major) Mathematical Physics (2016)

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

Bachelor's degree (1 major) Mathematical Physics (2020)

exchange program Physics (2023)

Bachelor's degree (1 major) Mathematical Physics (2024)

Bachelor's with 1 major Mathematical Physics	
(2016)	



Subfield Statistical Physics and Electrodynamics II

(10 ECTS credits)

	e title				Abbreviation		
Statist	ical Ph	ysics - Exercises			11-T-SA-152-m01		
Module	e coord	inator		Module offered by			
0	ing Dire	ector of the Institute o	f Theoretical Physics	Faculty of Physics and Astronomy			
ECTS	<u> </u>	od of grading	Only after succ. con	. compl. of module(s)			
5	1	rical grade					
Duratio	•	Module level Other prerequisites					
1 semester undergraduate							
Conten							
Among potent Ising m	g others ials, qu nodels,	Principles of statistic antum statistics, Ferm critical phenomena, e	s, Statistical Physics, id ni and Bose gas, system	eal systems, fundam	e content of 11 T-SEV content. ental theorems, thermodynamic cles, approximation methods,		
Intend	ed lear	ning outcomes					
and are to inter	e able t rpret th	o independently apply e results in a physical	/ them to the descriptio	n and solution of pro	lynamics and Statistical Physics blems of Statistical Physics and		
Ü (2)		t in: Ü: German or Eng		iiiidii)			
Metho	d of as	sessment (type, scope, lar		examination offered — if no	t every semester, information on whether		
		ole for bonus)					
		nation (approx. 120 m ssessment: German a					
Allocat	tion of	places					
Additic	onal inf	ormation					
Worklo	ad						
150 h							
Teaching cycle							
Teachi	ng cvci	e					
Teachi 	ng cyci	e					
			tions for teaching degree progra	ammes)			
			tions for teaching-degree progra	ammes)			
 Referre 	ed to in	LPOI (examination regula	tions for teaching-degree progra	ammes)			
 Referre Module	ed to in e appea	LPO I (examination regula		ammes)			
 Referre Module Bachel	ed to in e appea lor's de	LPOI (examination regula ars in gree (1 major) Physics	(2015)				
 Referre Module Bachel Bachel	ed to in e appea lor's de lor's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr	(2015) ucture Technology (201				
 Referre Module Bachel Bachel Bachel	ed to in e appea or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanosti gree (1 major) Mathem	(2015) ructure Technology (201 natical Physics (2015)				
 Referre Bachel Bachel Bachel Bachel Bachel	ed to in e appea or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Mathem	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016)				
 Referre Bachel Bachel Bachel Bachel Bachel Bachel	ed to in e appea or's de or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanosti gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020)	5)			
 Referre Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ed to in e appea or's de or's de or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics gree (1 major) Nanostr	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020) ructure Technology (202	5)			
 Referre Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ed to in e appea or's de or's de or's de or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020) ructure Technology (202 natical Physics (2020)	5)			
 Referre Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ed to in e appea or's de or's de or's de or's de or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Quantu	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020) ructure Technology (202 natical Physics (2020)	5)			
 Referre Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ed to in or's de or's de or's de or's de or's de or's de or's de or's de or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics gree (1 major) Nanostr gree (1 major) Mathem	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020) ructure Technology (202 natical Physics (2020) m Technology (2021)	5)			
 Referre Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ed to in or's de or's de	LPO I (examination regula ars in gree (1 major) Physics gree (1 major) Nanosti gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Physics gree (1 major) Nanosti gree (1 major) Mathem gree (1 major) Mathem gree (1 major) Quantu gram Physics (2023)	(2015) ructure Technology (201 natical Physics (2015) natical Physics (2016) (2020) ructure Technology (202) natical Physics (2021) natical Physics (2024)	5)	am. reg. da-		

Modul	le title			Abbreviation			
Electro	odynam	ics - Exercises			11-T-EA-152-m01		
Module coordinator				Module offered by			
-	ging Dir strophy	ector of the Institute of ⁻ sics	Theoretical Physics	Faculty of Physics and Astronomy			
			Only after succ. con	mpl. of module(s)			
5	nume	rical grade					
Duration Module level		Other prerequisites					
1 seme	ester	undergraduate					
Contents							
equati	ions, ele		atics, Maxwell equatio	ns in matter, dynami	s Mathematical tools, Maxwell's ic electromagnetic fields, electro-		
Intend	led lear	ning outcomes					
The students are familiar with the mathematical methods of theoretical electrodynamics and are able to inde- pendently apply them to the description and solution of problems of electrodynamics and to interpret the results in a physical manner.							
Course	es (type, 1	number of weekly contact hours	, language — if other than Ge	rman)			
Ü (2) Modul	le taugh	ıt in: Ü: German or Engli	sh				
		sessment (type, scope, lang ble for bonus)	uage — if other than German,	examination offered — if no	ot every semester, information on whether		
		nation (approx. 120 mir assessment: German an					
Alloca	tion of	places					
Additi	onal inf	ormation					
Workl	oad						
150 h							
-	ing cycl	e					
	- /						
Referr	ed to in	LPOI (examination regulation	ons for teaching-degree progra	ammes)			
				···,			
Modul	le appea	ars in					
		gree (1 major) Physics (2015)				
		gree (1 major) Mathema					
		gree (1 major) Mathema	,				
Bache	lor's de	gree (1 major) Physics (2020)				
	Bachelor's degree (1 major) Mathematical Physics (2020)						
	exchange program Physics (2023)						
Bache	lor's de	gree (1 major) Mathema	itical Physics (2024)				



Subfield Laboratory Course Physics

(15 ECTS credits)

	e title				Abbreviation
Labora	tory Co	ourse Physics A (Mechan	ics, Heat, Electron	nagnetism)	11-P-PA-152-m01
Modul	e coord	inator		Module offered	l by
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Phys	ics and Astronomy
ECTS	1	od of grading	E	compl. of module(s	· · · · ·
3		successfully completed			,
<u> </u>		Module level	Other prerequisi	tes	
1 seme		undergraduate			
Conter			1		
Measu rents,	rement heat ca		ity of bodies, dyna	amic viscosity, elas	e.g. measurement of voltages and cu ticity, surface tension, spring con-
Intend	ed lear	ning outcomes			
le to in measu	depeno ring pro	dently plan and conduct ptocol.	experiments, to co	ooperate with other	sperimenting techniques. They are a s, and to document the results in a
	es (type, r	number of weekly contact hours,	language — if other thai	i German)	
P (2)					
		S essment (type, scope, langua vle for bonus)	age — if other than Germ	an, examination offered	 if not every semester, information on whether
Prepar cessfu	ing, pei lly com	pleted if a Testat (exam)	(record of readings is passed. Exactly	one experiment th	experiments will be considered suc- at was not successfully completed ssion; approx. 30 minutes) to test th
Prepar cessfu can be candid pleted	ing, pei lly com repeat late's u	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	
Prepar cessfu can be candid pleted Allocat	ing, per lly com repeat late's u can be t ion of j	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio	ing, per lly com repeat late's u can be tion of p	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio	ing, per lly com repeat late's u can be tion of p	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio Worklo 90 h	ing, per lly com repeat late's u can be tion of p onal inf	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio Worklo 90 h	ing, per lly com repeat late's u can be tion of p	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation	(record of readings is passed. Exactly n of all experimen sics-related conter	one experiment th ts, talk (with discus its of the module. T	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi 	ing, per lly com repeat late's u can be tion of p onal inf pad	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as	one experiment th ts, talk (with discus its of the module. T assessment have to	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
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Prepar cessfu can be candid pleted Allocat Additio Yorklo 90 h Teachi Referro Modul	ing, per lly com repeat late's u can be tion of p onal inf pad ng cycl ed to in e appea	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPOI (examination regulation ars in	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as no for teaching-degree p	one experiment th ts, talk (with discus its of the module. T assessment have to	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio Worklo 90 h Teachi Referro Bache	ing, per lly com repeat late's u can be tion of p onal inf oad ng cycl ed to in e appea lor's de	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPOI (examination regulation	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as s for teaching-degree pr ics (2015)	one experiment th ts, talk (with discus its of the module. T assessment have to	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf onal inf oad ng cycl ed to in e appea lor's de lor's de lor's de	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as ns for teaching-degree pr cics (2015) 015) ture Technology (2	one experiment th ts, talk (with discuss of the module. T assessment have to ogrammes)	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf oad ng cycl ed to in e appea lor's de lor's de lor's de	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Mathemat	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as a for teaching-degree pu- sics (2015) o15) ture Technology (2 ical Physics (2015)	one experiment th ts, talk (with discuss of the module. T assessment have to ogrammes)	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat late's u can be tion of p onal inf onal inf oad ad ad ad ad ad ad ad ad ad ad ad ad a	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Computation	(record of readings is passed. Exactly n of all experimen sics-related conter mponents of the as s for teaching-degree pr cics (2015) 015) ture Technology (2 cical Physics (2015) ional Mathematics	one experiment th ts, talk (with discuss its of the module. T assessment have to ogrammes)	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf oad onal inf oad ad ad ad ad ad ad ad ad ad ad ad ad a	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Nathemat gree (1 major) Mathemat gree (1 major) Computati gree (1 major) Computati	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as s for teaching-degree particles (2015) oture Technology (2 ical Physics (2015) ional Mathematics c Computer Science	one experiment th ts, talk (with discuss its of the module. T assessment have to ogrammes) 2015) (2015) (2015) e (2015) e (2015)	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf onal inf oad ng cycl ed to in e appea lor's de lor's de lor's de lor's de lor's de lor's de lor's de lor's de	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Aerospace gree (1 major) Mathemat	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as ns for teaching-degree pr sics (2015) 015) ture Technology (2 ical Physics (2015) ional Mathematics computer Scienc cical Physics (2016)	one experiment th ts, talk (with discuss its of the module. T assessment have to ogrammes) (2015) (2015) (2015) e (2015) e (2015))	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Additio Worklo 90 h Teachi Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf oad onal inf oad ed to in e appea lor's de lor's de	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Nathemat gree (1 major) Mathemat gree (1 major) Computati gree (1 major) Computati	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as sis for teaching-degree pu- cics (2015) o15) ture Technology (2 ical Physics (2015) ional Mathematics computer Science cical Physics (2016) computer Science	one experiment th ts, talk (with discuss its of the module. T assessment have to ogrammes) (2015) (2015) (2015) e (2015) e (2015))	at was not successfully completed ssion; approx. 30 minutes) to test th alks that were not successfully com
Prepar cessfu can be candid pleted Allocat Worklo 90 h Teachi Referro Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel Bachel	ing, per ing, per lly com repeat ate's u can be tion of p onal inf onal inf oad ad ad ad ad ad ad ad ad ad ad ad ad a	forming and evaluating pleted if a Testat (exam) ed once. After completio nderstanding of the phys repeated once. Both cor places ormation e LPO I (examination regulation ars in gree (1 major) Mathemat gree (1 major) Nanostruc gree (1 major) Nanostruc gree (1 major) Mathemat gree (1 major) Computati gree (1 major) Aerospace gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Mathemat	(record of readings is passed. Exactly n of all experimen sics-related conter nponents of the as a for teaching-degree pr sics (2015) 015) ture Technology (2015) ital Physics (2015) ional Mathematics computer Science ical Physics (2016) concert concert computer Science 020)	one experiment th ts, talk (with discuss its of the module. T assessment have to ogrammes) (2015) (2015) (2015) e (2015) e (2015))	at was not successfully completed ssion; approx. 30 minutes) to test th falks that were not successfully com be successfully completed.

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Mathematics (2023) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module title Abbreviation						
Data ar	nd Erro	r Analysis			11-P-FR1-152-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of A	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
2	(not) s	successfully completed				
Duratio	n	Module level	Other prerequisites			
1 seme	1 semester undergraduate Admission prerequisite to assessment: completion of exercises (appro 13 exercise sheets per semester). Students who successfully complete approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginn of the semester.					/ completed sment. The
Conten	ts					
		s, error approximation a deviation.	ind propagation, graph	nic representations,	linear regression, me	ean values
Intende	ed lear	ning outcomes				
		are able to evaluate me to draw, present and di			gation and of the prin	nciples of
Course	S (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (1) + I Module		t in: Ü: German or Engli	sh			
Method	d of ass	sessment (type, scope, lang		examination offered — if no	t every semester, informat	ion on whether
		nation (approx. 120 min	utes)			
		ssessment: German an				
Allocat	ion of J	olaces				
Additio	nal inf	ormation				
this wil 3 Sente find tha gistrati ly regis sessme	l be co ence 4 / at the s on for a ter for a ent was	f a student registers for nsidered a declaration ASPO (general academi tudent has obtained th assessment into effect. an assessment. Studen not put into effect will which he/she has not be	of will to seek admissi c and examination reg e qualification for adm Only those students th ts who did not register not be admitted to the	on to assessment pu ulations). If the mod ission to assessmen nat meet the respect for an assessment of respective assessm	rsuant to Section 20 ule coordinators sub it, they will put the s ive prerequisites car or whose registratior ent. If a student take	o Subsection osequently tudent's re- n successful- n for an as- es an as-
Worklo	ad					
60 h						
Teachi	ng cycl	е				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
§ 53 N § 77 N						
Module	e appea	urs in				
Bachel	or's de	gree (1 major) Mathema gree (1 major) Physics (gree (1 major) Nanostru	2015)	5)		
Bachelor's	with 1 ma	or Mathematical Physics	JMU Würzburg	e generated 19-Apr-2025 • exa	am. reg. da-	page 39 / 147
(2016)			ta record Bachelo	r (180 ECTS) Mathematische	Physik - 2016	

UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Aerospace Computer Science (2015) Bachelor's degree (1 major) Functional Materials (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) First state examination for the teaching degree Grundschule Physics (2015) First state examination for the teaching degree Realschule Physics (2015) First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Mittelschule Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Aerospace Computer Science (2017) First state examination for the teaching degree Grundschule Physics (2018) First state examination for the teaching degree Realschule Physics (2018) First state examination for the teaching degree Gymnasium Physics (2018) First state examination for the teaching degree Mittelschule Physics (2018) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) First state examination for the teaching degree Grundschule Physics (2020) First state examination for the teaching degree Gymnasium Physics (2020) First state examination for the teaching degree Realschule Physics (2020) First state examination for the teaching degree Mittelschule Physics (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Mathematics (2023) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Functional Materials (2025)

Module	title				Abbreviation
Laborat	tory Co	urse Physics B for Stude	ents of Mathematical	Physics	11-P-MPB-152-m01
Module	e coord	inator		Module offered by	·
Managi	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
4	(not) s	successfully completed			
Duratio	n	Module level	Other prerequisites		
1-2 Sem	nester	undergraduate		recommended to co eting module 11-P-N	mplete modules 11-P-PA and 11- IPB.
Conten	ts		• •		
Physica	al laws	of optics, vibrations and	waves, science of ele	ectricity and circuits	with electric components.
Intende	ed lear	ning outcomes			
le to ind measur princip	depenc ring pro les of s	lently plan and conduct of	experiments, to coop valuate the measurin esent and discuss the	erate with others, ar g results on the bas conclusions.	menting techniques. They are ab- nd to document the results in a is of error propagation and of the
P (2)					
practica Prepari cessful can be candida	al assigng, per ly com repeat ate's u	le for bonus) gnment with talk (approx forming and evaluating (pleted if a Testat (exam) ed once. After completion	. 30 minutes) (record of readings or is passed. Exactly on n of all experiments, ics-related contents	lab report) the expe e experiment that wa talk (with discussior of the module. Talks	riments will be considered suc- as not successfully completed a; approx. 30 minutes) to test the that were not successfully com- uccessfully completed.
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
120 h			-		
Teachir	ıg cycl	e			
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	ummes)	
Module	appea	in and a second s			
Bachelo Bachelo	or's de or's de	gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Mathemat	ical Physics (2016) ical Physics (2020)		

Module	e title				Abbreviation
Labora	tory Co	ourse Physics C for Stude	nts of Mathematical	Physics	11-P-MPC-152-m01
Module	e coord	inator		Module offered by	
Manag	ing Dir	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	nd Astronomy
ECTS	Meth	od of grading	Only after succ. com	npl. of module(s)	
4	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1-2 sen	nester	undergraduate	Students are highly completing module		mplete module 11-P-MPB prior to
Conten	ts				
		of wave optics, Molecula ised devices with exampl			n measuring methods using spe
Intend	ed lear	ning outcomes			
to reco by usin	rd mea 1g error	suring results in a structu	ured manner, even in cs. They are able to e	case of huge data tr	erimental setups. They are able affic, and to analyse the results raw conclusions and to present
Course	S (type, 1	number of weekly contact hours, l	anguage — if other than Ger	rman)	
P (2)					
		sessment (type, scope, langua ble for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
Prepari cessful can be candid	ing, pei lly com repeat ate's u	pleted if a Testat (exam) i ed once. After completion	record of readings or is passed. Exactly on n of all experiments, t ics-related contents of	e experiment that wa talk (with discussion of the module. Talks	riments will be considered suc- as not successfully completed as approx. 30 minutes) to test the that were not successfully com- uccessfully completed.
Allocat	ion of	places			
Additio	onal inf	ormation			
			-		
Worklo	ad				
120 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
			<u>,</u>		
Module	e appea	ars in			
			ical Physics (2015)		
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016)					
	or s ae	gree (1 major) Mathemati	ical Physics (2016)		
Bachel Bachel	or's de	gree (1 major) Mathemati gree (1 major) Mathemati gree (1 major) Mathemati	ical Physics (2020)		

Module	e title				Abbreviation
Advand	ed and	Computational Data Ana	alysis		11-P-FR2-152-m01
Module	e coord	inator		Module offered by	<u> </u>
Manag	ing Dire	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	ind Astronomy
ECTS		od of grading	Only after succ. con		
	1		Only alter Succ. con		
2		successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate	Students are highly completing module		mplete module 11-P-FR1 prior t
Conten	ts				
		hods of data analysis an data analysis.	d error calculation. D	Distribution function,	significance tests, modelling.
Intend	ed lear	ning outcomes			
	method	ls of computerised data			error calculation. They have ma tained measuring data and to
Course	S (type, r	umber of weekly contact hours, l	anguage — if other than Ge	rman)	
V (1) +	Ü (1)				
Exercis	es (suc ment o	le for bonus) cessful completion of ap ffered: Once a year, sum Naces		. 10 exercise sheets)	
Allocal		Jiaces			
Additio	onal inf	ormation			
Worklo	ad				
60 h					
Teachi	ng cycl	e			
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	ammes)	
Madel					
Module)		
		gree (1 major) Physics (20	-	-)	
		gree (1 major) Nanostruct gree (1 major) Mathemati		5)	
		gree (1 major) Mathemati gree (1 major) Mathemati			
		gree (1 major) Physics (20	•		
		gree (1 major) Nanostruct		0)	
		gree (1 major) Mathemati		- /	
		gree (1 major) Functional	•		
		gree (1 major) Quantum T			
		gram Physics (2023)			
		gree (1 major) Mathemati	(a) Physics (acay)		
Bachel		Sice (I major) mathemati	ical Fliysics (2024)		



Compulsory Electives Mathematics

(22 ECTS credits)



Subgroup Basics of Mathematical Methods

(9 ECTS credits)

Modul	e title				Abbreviation
Introdu	uction t	o Differential Geometry			10-M-DGE-152-m01
Modul	e coord	inator		Module offered by	
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Meth	od of grading	Only after succ. com	pl. of module(s)	
9	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conten	nts		<u>I</u>		
particu	ılar) in I		ure of hypersurfaces,		bmanifolds (hypersurfaces in es, main theorem on local sur-
Intend	ed lear	ning outcomes			
	ed with				erential geometry. He/She is ac ental proof methods indepen-
Course	S (type, r	number of weekly contact hours, I	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
module is a) writt b) oral c) oral Langua Assess	s creditat cen exa examir examin age of a sment o	nle for bonus) mination (approx. 90 to 1 nation of one candidate e nation in groups (groups of nssessment: German and nffered: In the semester ir	80 minutes, usually (ach (15 to 30 minutes of 2, 10 to 15 minutes /or English	chosen) or 5) or per candidate)	ot every semester, information on whether
credita	ble for	bonus			
Allocat	tion of _l	places			
Additio	onal inf	ormation			
Worklo	ad				
270 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Referre		5			
	e appea	ars in			
 Module	e appea lor's de		cs (2015)		
 Modul e Bachel	or's de	ars in gree (1 major) Mathemati gree (1 major) Mathemati	-		
 Modul e Bachel Bachel	or's de or's de	gree (1 major) Mathemati	cal Physics (2015)	015)	
 Module Bachel Bachel Bachel	or's de or's de or's de	gree (1 major) Mathemati gree (1 major) Mathemati	cal Physics (2015) onal Mathematics (20	015)	

Module	e title				Abbreviation
Ordina	ry Diffe	erential Equations			10-M-DGL-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mather	natics
ECTS	Meth	od of grading	Only after succ. con	pl. of module(s)	
9	(not)	successfully completed			
Duratio	•	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts	1 0			
		uniqueness theorem; co tions; matrix exponentia			itial values; systems of linear dif igher order.
Intende	ed lear	ning outcomes			
		acquainted with the fun /she is able to apply the			heory of ordinary differential
Course	S (type, I	number of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
		s essment (type, scope, langua ole for bonus)	ge — if other than German, o	examination offered — if n	ot every semester, information on whether
c) oral	examir age of a	nation of one candidate e nation in groups (groups c issessment: German and, bonus	of 2, 10 to 15 minutes	-	
Allocat	ion of	places			
 Additio	onal inf	ormation			
Worklo	ad				
270 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Module					
		gree (1 major) Mathemati	-		
		gree (1 major) Mathemati			
Bachel		gree (1 major) Computatio	onal Mathematics (20	<u>م</u> ۱۲)	
		/		515)	
Bachel		gree (1 major) Mathemati gree (1 major) Mathemati	•	J1 <u></u>)	

Module	e title				Abbreviation
Introdu	uction t	o Complex Analysis			10-M-FTH-152-m01
Module	e coord	inator		Module offered by	l
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)	
9		successfully completed		•	
Duratio	<u> </u>	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
rems, i erstraß	solatec produ	l singularities, meromorp ct theorem and theorem o	hic functions and La	urent series, residue	grals and Cauchy integral theo- e theorem and applications, Wei
	-	ning outcomes			
		acquainted with the fun ethods to practical probl		nd methods in comp	olex analysis. He/she is able to
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)	
V (4) +	Ü (2)				
Metho	d of ass	sessment (type, scope, langua	ge — if other than German,	examination offered — if no	ot every semester, information on whether
		le for bonus)			
b) oral c) oral	examir examin age of a	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups of ssessment: German and bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or	
Allocat	ion of j	olaces			
Additio	onal inf	ormation			
Worklo	ad				
270 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	ammes)	
Module	e appea	ars in			
Bachel Bachel Bachel	or's de or's de or's de	gree (1 major) Mathemati gree (1 major) Mathemati gree (1 major) Computati	cal Physics (2015) onal Mathematics (20	015)	
		gree (1 major) Mathemati	•		
Bachel	or's de	gree (1 major) Mathemati	CS (2023)		

Module	e title				Abbreviation
Geome	tric An	alysis			10-M-GAN-152-m01
Module	e coord	inator		Module offered by	<u>I</u>
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
9	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites	;	
1 seme	ster	undergraduate			
Conten	ts		-		
		s in analysis on manifold tor analysis and topolog		ulus of differential f	orms, Stoke's theorem and appli-
Intende	ed lear	ning outcomes			
The stu	ident is		•	nd methods in geon	netric analysis. He/she is able to
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)	
V (4) +					
a) writt b) oral c) oral Langua credita	en exa examir examir ige of a ble for		each (15 to 30 minute of 2, 10 to 15 minutes	s) or	
Allocat	ion of	olaces			
Additio	nal inf	ormation			
Worklo	ad				
270 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regulation	is for teaching-degree progra	ammes)	
§ 22	Nr. 3 f)				
Module	e appea	ars in			
Bachel	or's de	gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Computati	ical Physics (2015)	o	

Image: The standing and st	Module	title				Abbreviation
Dear of Studies Mathematik (Mathematics) Institute of Mathematics ECTS Met→of grading Only after succ. compl. of module(s) 9 (not) successfully completed Duration Module level Other prerequisites 1 sem ster undergraduate Contents module level Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Intervent of states and Hilbert spaces, bounded operators, principles of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the boro applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German, examination of one candidate each (15 to 30 minutes) or or 0 y ord examination of one candidate each (15 to 30 minutes) or or or 0 y oral examination in groups (groups of 2, 10 to 15 minutes per candidate) language or assessment: German and/or English creditable for bouls a 270 h	Introdu	Introduction to Functional Analysis 10-M-FAN-152-mo1				
ECTS Meth→ of grading Only after succ. compl. of module(s) 9 (not) successfully completed Duration Module level Other prerequisites 1 sem ster undergraduate Contents Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Interded level Interded levering outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Û (2) Method of assessment (type, scope, language – if other than German, examination of one candidate each (15 to 30 minutes) or o) oral examination in groups (groups of 2, 10 to 15 minutes) or 0) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus	Module	coord	inator		Module offered by	
g (not) successfully completed Duration Module level Other prerequisites 1 semester undergraduate Contents Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Intended learning outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V V (a) + Û (2) 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 to 180 minutes, usually chosen) or b) oral examination in groups (groups of 2, 10 to 15 minutes) or c) or al examination in groups (groups of 2, 10 to 15 minutes) er candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Motkload 270 h Teaching cycle	Dean of Studies Mathematik (Mathematics)				Institute of Mathem	atics
Duration Module level Other prerequisites 1 semester undergraduate 1 semester undergraduate Contents Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Intended learning outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) or al examination ingroups (groups of 2, 10 to 15 minutes per candidate) language of assessment: German and/or English creditable for bonus Allocation of places Additional information 270 h Teaching cycle	ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
1 semester undergraduate Contents Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Intended learning outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) or c) or al examination of nor candidate each (15 to 30 minutes) or c) or c) or al examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Additional information	9	(not) s	successfully completed			
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Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis. Intended learning outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle	1 semes	ster	undergraduate			
Intended learning outcomes The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) or al examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Korkload 270 h Teaching cycle	Conten	ts				
The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle 	Banach	space	s and Hilbert spaces, bou	unded operators, prir	ciples of functional	analysis.
methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle	Intende	ed leari	ning outcomes			
V (4) + Ü (2) 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 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle	method	ls, is al	ole to apply methods fror	n linear algebra and a	analysis to functiona	
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 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Morkload 270 h Teaching cycle	Course	5 (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle	V (4) + l	Ü (2)				
b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Workload 270 h Teaching cycle 				ge — if other than German, e	examination offered — if no	t every semester, information on whether
Additional information Workload 270 h Teaching cycle	b) oral (c) oral (Langua credital	examin examin ge of a ole for	ation of one candidate e ation in groups (groups c ssessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or	
 Workload 270 h Teaching cycle	Allocat	ion of p	Diaces			
 Workload 270 h Teaching cycle			4 °			
270 h Teaching cycle	Additio	natinf	ormation			
270 h Teaching cycle	Worklo					
Teaching cycle		au				
			•			
Referred to in LPO I (examination regulations for teaching-degree programmes)	Teacini	ig cycl	6			
NCICITCA LO ITI EL O I (chammation regulations for leaching-degree programmes)	Referre	d to in	IPOI (examination regulations	for teaching degree progra	mmec)	
§ 22 Nr. 3 f)				s for teaching-degree progra	inities)	
Module appears in	_		irs in			
Bachelor's degree (1 major) Mathematics (2015)				cs (2015)		
Bachelor's degree (1 major) Mathematical Physics (2015)	Bachelo	or's de	gree (1 major) Mathemati	cal Physics (2015)		
Bachelor's degree (1 major) Computational Mathematics (2015)					-	
First state examination for the teaching degree Gymnasium Mathematics (2015)			-	• ,	Mathematics (2015)	
Bachelor's degree (1 major) Mathematical Physics (2016)				•	Mathamatics (as -)	
First state examination for the teaching degree Gymnasium Mathematics (2019) First state examination for the teaching degree Gymnasium Mathematics (2023)					-	
Bachelor's degree (1 major) Mathematics (2023)						

Module	e title				Abbreviation
Introdu	iction t	o Partial Differential Equ	ations		10-M-PAR-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mather	natics
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)	
9	1	successfully completed		•	
Duratio		Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten					
	orems,	basic equations of math			irst order, existence and uniquen ems, maximum principle and Di-
Intend	ed lear	ning outcomes			
		acquainted with the fun is able to apply these me			heory of partial differential equa
Course	S (type, r	number of weekly contact hours,	language — if other than Gei	rman)	
V (4) +	Ü (2)				
		sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if n	ot every semester, information on whether
Langua	ige of a ment o	ation in groups (groups o ssessment: German and ffered: In the semester ir bonus	/or English		ubsequent semester
Allocat	ion of _l	olaces			
Additio	onal inf	ormation			
Worklo	ad				
270 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Module	e appea	urs in			
		gree (1 major) Mathemat	ics (2015)		
		gree (1 major) Mathemat	· · ·		
		gree (1 major) Computati		015)	
		gree (1 major) Mathemat	ical Physics (2016)		
		gree (1 major) Mathemat	•		



Subfield Overview Mathematical Methods

(13 ECTS credits)

Overvi	e title				Abbreviation
312111	ew Diffe	erential Geometry and O	rdinary Differential Ec	quations for Mathe-	10-M-DGGD-PÜ-152-m01
matica	l Physi	cs			
Module coordinator Module offered by					
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
13	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conten	nts				
particu face th	ılar) in I eory, sı initial	Euclidean spaces, curvat pecial classes of surfaces values, systems of linear	ure of hypersurfaces, s; existence and uniq	geodesics, isometri ueness theorem, co	bmanifolds (hypersurfaces in es, main theorem on local sur- ntinuous dependence of soluti- I series, linear differential equati
		ning outcomes			
dinary	differer		s able to relate these	concepts with one a	al geometry and the theory of or- mother, and realises the advan-
Course	es (type, r	number of weekly contact hours, l	language — if other than Ger	man)	
V (4) +	Ü (2)		-		
		Sessment (type, scope, langua le for bonus)	age — if other than German, e	examination offered — if no	t every semester, information on whether
Assess may on	sment w nly be s verview	elected as the subject of	topics in pure mathe one examination in t	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
themat	,	ssessment: German and	/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat	age of a		/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua	age of a		/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat	age of a t ion of j		/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat	age of a t ion of j	olaces	/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat	age of a tion of p onal inf	olaces	/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat Additio	age of a tion of p onal inf	olaces	/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat Additio Worklo	age of a tion of p onal inf	ormation	/or English	rgänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat Additio Worklo 390 h	age of a tion of p onal inf	ormation	/or English	Ergänzung Mathema	tik (Supplementary Topics in Ma-
themat Langua Allocat Additio Worklo 390 h Teachin 	age of a tion of p onal inf oad	ormation			tik (Supplementary Topics in Ma-
themat Langua Allocat Additio Worklo 390 h Teachin	age of a tion of p onal inf oad	ormation e			tik (Supplementary Topics in Ma-
themat Langua Allocat Additio 390 h Teachin Referre	age of a tion of p onal inf pad ng cycl ed to in	ormation e LPOI (examination regulation			tik (Supplementary Topics in Ma-
themat Langua Allocat Additio 390 h Teachin Referre Module	age of a tion of p onal inf oad ng cycl ed to in e appea	ormation e LPOI (examination regulation	s for teaching-degree progra		tik (Supplementary Topics in Ma
themat Langua Allocat Additio 390 h Teachin Referre Bachel	age of a tion of p onal inf oad ng cycl ed to in e appea or's de	ormation e LPOI (examination regulation ars in gree (1 major) Mathemati	s for teaching-degree progra ical Physics (2015)		tik (Supplementary Topics in Ma-
themat Langua Allocat Additio 390 h Teachin Referre Bachel Bachel Bachel	age of a tion of p onal inf oad ag cycl ed to in e appea lor's de or's de	ormation e LPOI (examination regulation	s for teaching-degree progra ical Physics (2015) ical Physics (2016)		tik (Supplementary Topics in Ma

Module title 4					Abbreviation	
Overvi	ew Com	plex Analysis and Differ	ential Geometry for M	Aathematical Phy-	10-M-FTDG-PÜ-152-m01	
sics						
Module coordinator Module offered by						
Dean o	of Studio	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
13	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	Its		·			
rems, i erstraß Frenet	solated produce quatic	l singularities, meromorp ct theorem and theorem ons, local classification, s	hic functions and La of Mittag-Leffler, conf submanifolds (hypers	urent series, residue formal maps; curves surfaces in particula	grals and Cauchy integral theo- theorem and applications, Wei- in Euclidean spaces, curvature,) in Euclidean spaces, curvature special classes of surfaces.	
Intend	ed lear	ning outcomes				
try. He,	/She is		epts with one anothe		analysis and differential geome- dvantages of thinking across the	
Course	S (type, r	umber of weekly contact hours, l	anguage — if other than Gei	rman)		
V (4) +	Ü (2)					
		s essment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess may or den (O themat	ment w nly be s verview tics).	elected as the subject of	topics in pure mathe one examination in t or in module group I	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma-	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)		
Module	e appea	irs in				
Bachel	or's de	gree (1 major) Mathemati	ical Physics (2015)			
		gree (1 major) Mathemati	•			
		gree (1 major) Mathemati	•			
Bachel	or's de	gree (1 major) Mathemati	ical Physics (2024)			

Module title					Abbreviation	
Overvie	ew Com	plex Analysis and Ordin	ary Differential Equat	ions for Mathema-	10-M-FTGD-PÜ-152-m01	
tical Ph	nysics					
Module	Module coordinator Module offered by					
Dean o	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
13	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts		<u>I</u>			
erstraß continu al serie Intende	produc uous de es, linea ed learn	ct theorem and theorem of pendence of solutions o ar differential equations o ning outcomes	of Mittag-Leffler, conf n initial values, syste of higher order.	ormal maps; exister ms of linear differer	theorem and applications, Wei- nce and uniqueness theorem, itial equations, matrix exponenti analysis and the theory of ordi-	
nary di	fferenti		able to relate these co	oncepts with one an	other, and realises the advanta-	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
		s essment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
Assess may on den (Ov themat	ment w Ily be so verview ics).	elected as the subject of	topics in pure mathe one examination in t or in module group E	he sub-field Gesamt	oon with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma	
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Worklo	ad					
390 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Module	e appea	in in				
		gree (1 major) Mathemati	ical Physics (2015)			
	Bachelor's degree (1 major) Mathematical Physics (2016)					
Bachel		gree (1 major) Mathemati gree (1 major) Mathemati	-			

Module title Abbreviation					Abbreviation	
Overvie	ew Geo	metric Analysis and Diffe	erential Geometry for	Mathematical Phy-	10-M-GADG-PÜ-152-m01	
sics	sics					
Module	Module coordinator Module offered by					
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
13	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
cations tion, su	in vec Ibmani	tor analysis and topology	; curves in Euclidean articular) in Euclidea	spaces, curvature, l n spaces, curvature	orms, Stoke's theorem and appli- Frenet equations, local classifica- of hypersurfaces, geodesics, iso-	
Intende	ed leari	ning outcomes				
metry. I	He/She	•	oncepts with one and	-	c analysis and differential geo- le advantages of thinking across	
Course	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
		e essment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
Assess may on den (Ov themat	ment w ly be so verview ics).	elected as the subject of	topics in pure mathe one examination in t or in module group I	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho- tik (Supplementary Topics in Ma-	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
390 h						
Teachir	ng cycl	9				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	e appea	irs in				
		gree (1 major) Mathemati	cal Physics (2015)			
		gree (1 major) Mathemati	•			
		gree (1 major) Mathemati	•			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)			

Module title	Module title Abbreviation					
Overview Geo	Overview Geometric Analysis and Ordinary Differential Equations for Mathe- 10-M-GAGD-PÜ-152-mo1					
matical Physics						
Module coordinator Module offered by						
Dean of Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics		
ECTS Metho	od of grading	Only after succ. con	pl. of module(s)			
13 nume	rical grade					
Duration	Module level	Other prerequisites				
1 semester	undergraduate					
Contents						
lications in ve	ctor analysis and topolog values, systems of linear	y; existence and uni	queness theorem; co	orms, Stoke's theorem and app- ontinuous dependence of soluti- Il series, linear differential equati-		
Intended lear	ning outcomes					
nary differenti		able to relate these c	oncepts with one an	c analysis and the theory of ordi- other, and realises the advanta-		
Courses (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)			
V (4) + Ü (2)						
Method of ass module is creditab		ge — if other than German, o	examination offered — if no	ot every semester, information on whether		
Assessment w may only be so den (Overview thematics).	elected as the subject of	topics in pure mathe one examination in t or in module group I	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho- tik (Supplementary Topics in Ma-		
Allocation of p	olaces					
Additional info	ormation					
Workload						
390 h						
Teaching cycl	e					
Referred to in	LPO I (examination regulations	s for teaching-degree progra	mmes)			
Module appea	in in					
Bachelor's de	gree (1 major) Mathemati	cal Physics (2015)				
	gree (1 major) Mathemati	•				
	gree (1 major) Mathemati	•				
Bachelor's de	gree (1 major) Mathemati	cal Physics (2024)				

	e title				Abbreviation	
Overvie	ew Geo	metric Analysis and Com	plex Analysis for Ma	thematical Physics	10-M-GAFT-PÜ-152-m01	
Module coordinator Module offered b					V	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
13	1	rical grade		•		
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten						
lication path in	ns in ve tegrals	ctor analysis and topolog and Cauchy integral the	gy; complex different orems, isolated singu	iability and Cauchy-F Ilarities, meromorph	orms, Stoke's theorem and app- Riemann differential equations, ic functions and Laurent series, Mittag-Leffler, conformal maps.	
Intende	ed lear	ning outcomes				
sis. He	/She is		cepts with one anoth		c analysis and complex analy- advantages of thinking across the	
Course	S (type, r	number of weekly contact hours,	language — if other than Ger	rman)		
V (4) +	Ü (2)					
		Sessment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	t every semester, information on whether	
oral exa Assess may on den (Ov themat	aminat ment w Ily be s verview cics).	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods)	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma-	
oral exa Assess may on den (Ov themat	aminat ment w nly be s verview cics). age of a	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua	aminat ment w nly be s verview cics). age of a	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat	aminat ment w nly be s verview tics). age of a tion of p	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat	aminat ment w nly be s verview tics). age of a tion of p	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and blaces	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio	aminat ment w ily be s verview ics). age of a ion of j	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and blaces	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo	aminat ment w ily be s verview ics). age of a ion of j	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and blaces	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo 390 h	aminat ment w nly be s verview cics). age of a ion of p onal inf	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo	aminat ment w nly be s verview cics). age of a ion of p onal inf	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation	topics in pure mathe one examination in t) or in module group I	he sub-field Gesamt	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin 	aminat ment w nly be s verview cics). age of a ion of p onal inf pad	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation e	topics in pure mathe one examination in t) or in module group I /or English	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin 	aminat ment w nly be s verview cics). age of a ion of p onal inf pad	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation	topics in pure mathe one examination in t) or in module group I /or English	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin Referre	aminat ment w nly be s verview cics). age of a ion of p onal inf pad	ion of one candidate eac iin of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and olaces ormation e LPO I (examination regulation	topics in pure mathe one examination in t) or in module group I /or English	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Worklo 390 h Teachin Referre Module	aminat ment w nly be s verview cics). age of a ion of p onal inf pad ng cycl ed to in	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation e LPOI (examination regulation	topics in pure mathe one examination in t) or in module group f /or English 	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	
oral exa Assess may on den (O themat Langua Allocat Additio Worklo 390 h Teachin Referre Bachel	aminat ment w ily be s verview ics). age of a ion of p onal inf onal inf oad ad ed to in e appea or's de	ion of one candidate eac iin of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and olaces ormation e LPO I (examination regulation	topics in pure mathe one examination in t) or in module group I /or English s for teaching-degree progra	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	
oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin Referre Bachel Bachel	aminat ment w nly be s verview cics). age of a ion of p onal inf onal inf oad ad ad ad to in e appea or's de or's de	ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods) ssessment: German and places ormation e LPO I (examination regulation ars in gree (1 major) Mathemati	topics in pure mathe one examination in t) or in module group I /or English s for teaching-degree progra ical Physics (2015) ical Physics (2016)	he sub-field Gesamt Ergänzung Mathema	überblick Mathematische Metho	

Module title Abbreviation						
Overview	Overview Functional Analysis and Differential Geometry for Mathematical Phy- 10-M-FADG-PÜ-152-m01					
sics						
Module c	oordinator		Module offered by			
Dean of S	tudies Mathematik (Mathema	atics)	Institute of Mathem	atics		
	Nethod of grading	Only after succ. com				
	umerical grade					
Duration	Module level	Other prerequisites				
1 semeste						
Contents		L				
		unded operators prir	ciplos of functional	analysis; curves in Euclidean		
				irfaces in particular) in Euclidean		
				al surface theory, special classes		
of surface				· · ·		
Intended	learning outcomes					
The stude	ent is acquainted with fundam	nental concepts and r	nethods in differenti	al geometry and functional ana-		
lysis. He/	She is able to relate these co	ncepts with one anot		advantages of thinking across		
the borde	ers of different branches in ma	athematics.				
Courses (type, number of weekly contact hours, l	anguage — if other than Ger	man)			
V (4) + Ü	(2)					
Method o	f assessment (type, scope, langua	ge — if other than German, e	examination offered — if no	t every semester, information on whether		
module is cr	editable for bonus)					
oral exam	nination of one candidate eac	h (20 to 40 minutes)				
				on with the examiner. Each topic		
				überblick Mathematische Metho-		
thematics		or in module group i	rganzung Mathemat	tik (Supplementary Topics in Ma-		
	of assessment: German and	/or English				
	n of places					
Additiona	al information					
Workload						
390 h	•					
Teaching	cvcle	·				
Referred	to in LPO I (examination regulation	s for teaching-degree progra	mmes)			
Module a	ppears in					
	s degree (1 major) Mathemati	cal Physics (2015)				
	s degree (1 major) Mathemati					
	s degree (1 major) Mathemati					
	s degree (1 major) Mathemati					
		, <u>,</u> , , , , , , , , , , , , , , , , ,				

Module title Abbreviation						
Overvie matica		ctional Analysis and Ordi cs	nary Differential Equ	ations for Mathe-	10-M-FAGD-PÜ-152-m01	
Module coordinator Module offered by						
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Meth	od of grading	Only after succ. con	pl. of module(s)		
13		rical grade		• • • •		
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten						
ess the	orem,		of solutions on initial	values, systems of	analysis; existence and uniquen linear differential equations, ma-	
Intende	ed lear	ning outcomes				
nary di	fferenti		able to relate these c	oncepts with one an	al analysis and the theory of ordi- other, and realises the advanta-	
Course	S (type, 1	number of weekly contact hours, l	anguage — if other than Gei	rman)		
V (4) +	Ü (2)					
module is oral exa Assess may on	aminat ment v ly be s verviev	^{ole for bonus)} ion of one candidate eacl vill have reference to two elected as the subject of	h (20 to 40 minutes) topics in pure mathe one examination in t	matics as agreed up he sub-field Gesamt	ot every semester, information on whether bon with the examiner. Each topic tüberblick Mathematische Metho- tik (Supplementary Topics in Ma-	
	,	ssessment: German and,	/or English			
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cvcl	e				
	0 - 9 5					
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	anne	ars in				
		gree (1 major) Mathemati	cal Physics (2015)			
		gree (1 major) Mathemati				
		gree (1 major) Mathemati	•			
Dachal	Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2024)					

	e title				Abbreviation
Overvie	ew Fun	ctional Analysis and Cor	nplex Analysis for Ma	thematical Physics	10-M-FAFT-PÜ-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
13		rical grade		• • • •	
Duratio		Module level	Other prerequisites	i	
1 seme	ster	undergraduate			
Conten					
lity and ties, me and the	d Cauch eromor eorem o	y-Riemann differential e phic functions and Laur of Mittag-Leffler, conforn	quations, path integr ent series, residue the	als and Cauchy integ	analysis; complex differentiabi- gral theorems, isolated singulari- ons, Weierstraß product theorem
Intende	ed lear	ning outcomes			
sis. He	/She is		cepts with one anoth		al analysis and complex analy- advantages of thinking across th
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)	
V (4) +	Ü (2)				
module is	s creditab	le for bonus)		examination offered — if no	ot every semester, information on whether
oral exa Assess may on den (Ov themat	s creditab aminat ment w nly be s verview tics).	le for bonus) ion of one candidate ead vill have reference to two elected as the subject of	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
oral exa Assess may on den (Ov themat	s creditab aminat ment w nly be s verview tics). age of a	le for bonus) ion of one candidate eac rill have reference to two elected as the subject of Mathematical Methods ssessment: German and	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua	s creditab aminat ment w nly be s verview tics). age of a	le for bonus) ion of one candidate eac rill have reference to two elected as the subject of Mathematical Methods ssessment: German and	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	ot every semester, information on whether on with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma
module is oral exa Assess may on den (Ov themat Langua Allocat	s creditab aminat ment w nly be s verview tics). age of a tion of j	le for bonus) ion of one candidate eac rill have reference to two elected as the subject of Mathematical Methods ssessment: German and	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat	s creditab aminat ment w nly be s verview tics). age of a tion of j	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat	s creditab aminat ment w ily be s verview tics). age of a tion of p	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo	s creditab aminat ment w ily be s verview tics). age of a tion of p	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio Syo h	s creditab aminat ment w ily be s verview tics). age of a sion of j	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces ormation	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo	s creditab aminat ment w ily be s verview tics). age of a sion of j	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces ormation	ch (20 to 40 minutes) topics in pure mathe f one examination in t) or in module group I	matics as agreed up he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin 	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf	le for bonus) ion of one candidate eac rill have reference to two elected as the subject o r Mathematical Methods ssessment: German and places ormation	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group l l/or English	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin 	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and blaces ormation	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group l l/or English	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin Referre 	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf pad	le for bonus) ion of one candidate eac /ill have reference to two elected as the subject of / Mathematical Methods ssessment: German and olaces ormation e LPO I (examination regulation	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group l l/or English	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topic überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo 390 h Teachin Referre Module	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf onal inf oad	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and olaces ormation e LPO I (examination regulation ars in	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group I I/or English	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topi überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio Worklo 390 h Teachin Referre Bachel	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf onal inf onal inf oad ed to in e appea or's de	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and olaces ormation e E LPO I (examination regulation ars in gree (1 major) Mathemat	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group I I/or English	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topi überblick Mathematische Metho
module is oral exa Assess may on den (Ov themat Langua Allocat Additio 390 h Teachin Referre Bachel Bachel	s creditab aminat ment w nly be s verview tics). age of a tion of p onal inf onal inf oad ad ed to in e appea or's de or's de	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of v Mathematical Methods ssessment: German and olaces ormation e LPO I (examination regulation ars in	ch (20 to 40 minutes) o topics in pure mathe f one examination in t) or in module group l l/or English is for teaching-degree progra	ematics as agreed up he sub-field Gesamt Ergänzung Mathema	on with the examiner. Each topi überblick Mathematische Metho

Module	Module title Abbreviation					
Overvi	Overview Functional Analysis and Geometric Analysis for Mathematical Phy- 10-M-FAGA-PÜ-152-mo1					
sics	sics					
Module	Module coordinator Module offered by					
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Meth	od of grading	Only after succ. com	pl. of module(s)		
13	1	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten		1	I			
	manifo	lds, submanifolds, calcul			analysis; fundamentals in analy- and applications in vector analy-	
Intend	ed lear	ning outcomes				
sis. He	/She is		cepts with one anothe		al analysis and geometric analy- advantages of thinking across the	
Course	S (type, 1	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
module is oral exa Assess may or	aminat ment v ly be s	le for bonus) ion of one candidate eac vill have reference to two elected as the subject of	h (20 to 40 minutes) topics in pure mathe one examination in t	matics as agreed up he sub-field Gesamt	ot every semester, information on whether oon with the examiner. Each topic tüberblick Mathematische Metho-	
themat	ics).	ssessment: German and		rganzung Mathema	tik (Supplementary Topics in Ma-	
Allocat	ion of	olaces				
Additio	onal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cvcl	e				
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		
			3 ac2.cc p/05/d	/		
Module	e appe	ars in				
		gree (1 major) Mathemati	ical Physics (2015)			
		gree (1 major) Mathemati	,			
	Bachelor's degree (1 major) Mathematical Physics (2010) Bachelor's degree (1 major) Mathematical Physics (2020)					
	Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2024)					

Module title Abbreviation					Abbreviation	
Overvie	Overview Differential Geometry and Partial Differential Equations for Mathe- 10-M-DGPA-PÜ-152-mo1					
matica	matical Physics					
Module	Module coordinator Module offered by					
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
13		rical grade		•		
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts		<u> </u>			
particu face the ons of f	lar) in E eory, sp first orc	Euclidean spaces, curvati pecial classes of surfaces	ure of hypersurfaces, ; examples of partial mess theorems, basi	geodesics, isometri differential equatio	bmanifolds (hypersurfaces in es, main theorem on local sur- ns and partial differential equati- ematical physics, boundary value	
Intende	ed lear	ning outcomes				
partial	differe		s able to relate these	concepts with one	ial geometry and the theory of another, and realises the advan-	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	man)		
V (4) +	Ü (2)					
		eessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
Assess may on den (Ov themat	ment w ly be s verview ics).	elected as the subject of	topics in pure mathe one examination in t or in module group I	he sub-field Gesamt	oon with the examiner. Each topic überblick Mathematische Metho- tik (Supplementary Topics in Ma-	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
		· · · · · · · · · · · · · · · · · · ·				
Module	e appea	ars in				
		gree (1 major) Mathemati	cal Physics (2015)			
		gree (1 major) Mathemati				
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2020)			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)			

Overview Undergrand Differential Equations and Partial Differential Equations for Mathematics 10-M-GDPA-PÜ-152-m01 Module Control Module offered by Dear of Studies Mathematick (Mathematics) Insitute of Mathematics 13 numerical grade Daration Module level Other prerequisites Contents Existe not environmental equations of nighter order; examples of partial differential equations. Courses (pre, number of weekly content hange or if other than German, warmingtion offerent in a sequence of thinking across the offerent thange or in the descentibe of the examiner. Courses (pre, number of weekly content hange or if other than German, warmingtion offerent -if not every senset, information on whether madue is creditable for boux) Orevic	Module	title				Abbreviation			
Dean of Studies Mathematik (Mathematics) Institute of Mathematics ECTS Method of grading Only after succ. compl. of module(s) 13 numerical grade Duration Module level Other prerequisites 1 semester undergraduate Contents Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations of mathematical physics, boundary value problems, maximum principle and Unichet problem. Intended learning outcomes The student is acquainted with fundamental concepts and methods in the theory of ordinary and partial differential equations, he/s he is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics. Courses (yee, number of weekly contact hours, language — if other than German) Courses (yee, number of weekly contact hours, language — if other than German) V (a) + Ü (z) Mathematics as agreed upon with the examiner. Each topic madue is creditable for bonus) Contents Mathematics) Language of assessment (type, scope, language – if other than German, examination offered – if not every sensetse, information on whether madue is creditable for bonus) Course (yee, very sensetse, information on whether madue is creditable for bonus) Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic in any only be selected as the subjec			• •	ential Equations for	10-M-GDPA-PÜ-152-m01				
ECTS Method of grading Only after succ. compl. of module(s) 13 numerical grade - Duration Module level Other prerequisites 1 semester undergraduate - Contents Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations of higher order, examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem. Intended learning outcomes The student is acquainted with fundamental concepts and methods in the theory of ordinary and partial differential equations of higher order, existence and uniqueness the oborders of different branches in mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (4) (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) oral examination of one candidate each (20 to 40 minutes) Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-field Gesamtüberblick Mathematisch Methoden (overview Mathematical Methods) or in module group Ergänzung Mathematik (Supplementary Topics in Mathematical Methods) or in module group Ergänzung Mathematik (Supplementary Topics in Mathematical Methods) or in module group Ergänzung Mathem	Module	Module coordinator Module offered by							
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Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order; examples of partial differential equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem. Intended learning outcomes The student is acquainted with fundamental concepts and methods in the theory of ordinary and partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German) V (a) + Ü (z) Method of assessment (type, scope, language – if other than German, examination offered – if not every senester, information on whether module is creditable for bonus) oral examination of one candidate each (20 to 40 minutes) Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-field Gesamtüberblick Mathematics Methods). Language of assessment: German and/or English Allocation of places	1 seme	ster	undergraduate						
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tial equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (a) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) oral examination of one candidate each (20 to 40 minutes) Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-field Gesamtüberblick Mathematische Methoden (Overview Mathematical Methods) or in module group Ergänzung Mathematik (Supplementary Topics in Mathematics). Language of assessment: German and/or English Allocation of places Morkload 390 h Teaching cycle Module appears in Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2020)	Intende	ed learr	ning outcomes						
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Additional information Workload 390 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2020)	Assessi may on den (Ov themat	ment w ly be so verview ics).	ill have reference to two elected as the subject of Mathematical Methods)	topics in pure mathe one examination in t or in module group E	he sub-field Gesamt	überblick Mathematische Metho-			
 Workload 390 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2020)	Allocat	ion of p	olaces						
 Workload 390 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2020)									
390 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	Additio	nal inf	ormation						
390 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)									
Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	Worklo	ad							
Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	390 h								
Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	Teachir	ng cycl	9						
Module appears in Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)									
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	Referre	d to in	LPOI (examination regulations	s for teaching-degree progra	mmes)				
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)									
Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020)	Module	e appea	irs in						
Bachelor's degree (1 major) Mathematical Physics (2020)				,					
				,					
				•					

Module	e title				Abbreviation
Overvie	ew Com	plex Analysis and Partia	l Differential Equatio	ns for Mathemati-	10-M-FTPA-PÜ-152-m01
cal Phy	sics				
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)	
13	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
rems, is	solated		hic functions and La	urent series, residue	grals and Cauchy integral theo- theorem and applications, Wei-
Intende	ed lear	ning outcomes			
differer	ntial eq		o relate these conce	pts with one anothe	analysis and the theory of partia r, and realises the advantages of
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V (4) +	Ü (2)				
module is oral exa Assess may on den (Ov themat	arreditab aminat ment w ly be s verview ics).	le for bonus) ion of one candidate each vill have reference to two elected as the subject of v Mathematical Methods)	h (20 to 40 minutes) topics in pure mathe one examination in t or in module group F	matics as agreed up he sub-field Gesamt	ot every semester, information on whether bon with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma
	-	ssessment: German and,	/or English		
Allocat	ion of _l	olaces			
Additio	nal inf	ormation			
Worklo	ad				
390 h					
Teachi	ıg cycl	e			
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	immes)	
Module	appea	urs in			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2015)		
		gree (1 major) Mathemati	•		
		gree (1 major) Mathemati	•		
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)		

Module title Abbreviation						
Overvie	Overview Geometric Analysis and Partial Differential Equations for Mathemati-					
	cal Physics					
Module coordinator				Module offered by		
Dean of	Dean of Studies Mathematik (Mathematics)			Institute of Mathem	atics	
ECTS				pl. of module(s)		
13	numerical grade					
	Duration Module level Other prerequisites					
Conten						
applica uniquei	tions ii ness th	n vector calculus and top	ology, examples of fi	rst order partial diffe	forms, Stoke's theorem and its erential equations, existence and e theorems, maximum principle	
Intende	ed leari	ning outcomes				
al differ	rential		e to relate these con	cepts with one anoth	c analysis and the theory of parti- her, and realises the advantages	
Courses	S (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)		
V (4) + l	Ü (2)					
		s essment (type, scope, langua ₎ le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
oral examination of one candidate each (20 to 40 minutes) Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-field Gesamtüberblick Mathematische Metho- den (Overview Mathematical Methods) or in module group Ergänzung Mathematik (Supplementary Topics in Ma- thematics). Language of assessment: German and/or English						
Allocati	ion of p	olaces				
Additio	nal inf	ormation				
Workload						
390 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Bachelor's degree (1 major) Mathematical Physics (2015)						
	Bachelor's degree (1 major) Mathematical Physics (2016)					
Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelo	Bachelor's degree (1 major) Mathematical Physics (2024)					

Module title Abbreviation					Abbreviation	
Overview Functional Analysis and Partial Differential Equations for Mathemati- cal Physics						
				Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS	1	od of grading	Only after succ. com	pl. of module(s)		
13	1	rical grade				
Duratio						
	Contents					
ferentia	al equa	tions and partial differen	tial equations of first	order, existence and	analysis; examples of partial dif- d uniqueness theorems, basic ple and Dirichlet problem.	
Intende	ed lear	ning outcomes				
tial diff	erentia		ole to relate these co	ncepts with one ano	al analysis and the theory of par- ther, and realises the advantages	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
module is	s creditab	le for bonus)		examination offered — if no	t every semester, information on whether	
Assess may on den (O ^v themat	ment w Ily be s verview ics).	elected as the subject of	topics in pure mathe one examination in t or in module group E	he sub-field Gesamt	on with the examiner. Each topic überblick Mathematische Metho- tik (Supplementary Topics in Ma-	
Allocat	ion of _l	olaces				
Additio	onal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cycl	e				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	e appez	ars in				
		gree (1 major) Mathemati	cal Physics (2015)			
Bachelor's degree (1 major) Mathematical Physics (2016)						
Bachelor's degree (1 major) Mathematical Physics (2020)						
		gree (1 major) Mathemati	•			



Mathematical Physics

(18 ECTS credits)



Module Group Supplementary Topics in Mathematics

(ECTS credits)

Module title					Abbreviation	
Numerical Mathematics 1 for Mathematical Physics 10-M-NUM1P-152-m01					10-M-NUM1P-152-m01	
Module coordinator				Module offered by	I	
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathen	natics	
ECTS	Meth	od of grading	Only after succ. con	pl. of module(s)		
10	nume	numerical grade				
			Other prerequisites			
1 semester undergraduate						
Conter	Contents					
		stems of linear equations tion with polynomials, sp			quations and systems of equati- rical integration.	
Intend	ed lear	ning outcomes				
		acquainted with the fun oblems and knows about			erical mathematics, applies them	
Course	es (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
		s essment (type, scope, langua ble for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether	
b) oral c) oral Langua	examir examir	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups c nssessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Alloca	tion of	places				
Additi	onal inf	ormation				
Worklo	oad					
300 h						
Teaching cycle						
Referr	ed to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Modul	e appea	ars in				
Bache	lor's de	gree (1 major) Mathemati	cal Physics (2015)			
Bachelor's degree (1 major) Mathematical Physics (2016)						
Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelor's degree (1 major) Mathematical Physics (2024)						

Module title					Abbreviation	
Numerical Mathematics 2 for Mathematical Physics				10-M-NUM2P-152-m01		
Module coordinator				Module offered by	,	
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mather	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
10	nume	numerical grade				
Durati	Duration Module level Other prerequisite					
1 semester undergraduate						
Conter	nts		<u> </u>			
		oblems, linear programm Je problems.	ing, methods for init	ial value problems f	or ordinary differential equations,	
Intend	ed lear	ning outcomes				
about and er	their ac ngineeri		concerning the poss ics.	sibilities of application	nerical mathematics and knows ion in different fields of natural	
V (4) +						
b) oral c) oral Langua	examir examir	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups c ssessment: German and, bonus	ach (15 to 30 minute of 2, 10 to 15 minutes	s) or		
	tion of					
Additi	onal inf	ormation				
Worklo	oad					
300 h						
-	ing cycl	e				
Referre	ed to in	LPO I (examination regulations	s for teaching-degree progra	ammes)		
Modul	e appea	ars in				
		gree (1 major) Mathemati	cal Physics (2015)			
Bachelor's degree (1 major) Mathematical Physics (2016)						
	Bachelor's degree (1 major) Mathematical Physics (2020)					
Bache	Bachelor's degree (1 major) Mathematical Physics (2024)					

Module title					Abbreviation	
Stochastics 1 for Mathematical Physics					10-M-ST01P-152-m01	
Module coordinator Module Coordinator			Module offered by	/		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathe	matics	
ECTS	Method of grading Only after succ. compl. of module(s)					
10		rical grade				
			Other prerequisites			
1 semester undergraduate						
Conten	Contents					
continu chastic	ious di indep	stributions: normal distri	bution, random varia ditional probability,	ble, distribution fu characteristics of d	easure and integration theory, nction, product measures and sto- istributions: expected value and	
Intende	ed lear	ning outcomes				
The stu	dent is				tics, applies these methods to	
Course	S (type, 1	number of weekly contact hours, l	anguage — if other than Gei	rman)		
V (4) +	Ü (2)					
		sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if i	not every semester, information on whether	
b) oral c) oral	examir examir Ige of a	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups o ssessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	immes)		
Module	e appea	ars in				
Bachel Bachel	or's de or's de	gree (1 major) Mathemati gree (1 major) Mathemati gree (1 major) Mathemati	cal Physics (2016) cal Physics (2020)			
Bachelor's degree (1 major) Mathematical Physics (2024)						

Module	e title				Abbreviation
Stocha	stics 2	for Mathematical Physic	S		10-M-STO2P-152-m01
Module	e coord	inator		Module offered by	1
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics
ECTS	TS Method of grading Only after succ.		Only after succ. con	npl. of module(s)	
10	numerical grade				
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Elemen	nts of d	ata analysis, statistics of	data in normal and c	other distributions, e	elements of multivariate statistics.
Intende	ed lear	ning outcomes			
		acquainted with fundam and knows about the ty			s, applies these methods to prac-
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	man)	
V (4) +	Ü (2)				
		Sessment (type, scope, langua Ile for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether
c) oral	examin Ige of a	nation of one candidate e ation in groups (groups o ssessment: German and, bonus	of 2, 10 to 15 minutes	-	
Allocat	ion of _l	olaces			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
		gree (1 major) Mathemati			
		gree (1 major) Mathemati gree (1 major) Mathemati	-		
		gree (1 major) Mathemati gree (1 major) Mathemati	•		
Duchel	or 5 ue	Siec (I major) Mathemati	cuti ilysics (2024)		

Module	e title			1	Abbreviation
Introduction to Algebra for Mathematical Physics 10-M-ALGP-152-mo1					10-M-ALGP-152-m01
Module	e coord	inator		Module offered by	
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conten	nts				
Fundar	mental	algebraic structures (grou	ups, rings, fields), Ga	lois theory.	
Intend	ed lear	ning outcomes			
		nows and masters the es ncepts in this field, and is			ebra. He/She is acquainted with ethods independently.
		number of weekly contact hours, l		•	
V (4) +	Ü (2)		,		
		Sessment (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether
c) oral Langua	examin	nation of one candidate e ation in groups (groups o ssessment: German and, bonus	of 2, 10 to 15 minutes	-	
Allocat	tion of _l	olaces			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
	_				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
		gree (1 major) Mathemati			
		gree (1 major) Mathemati	•		
		gree (1 major) Mathemati gree (1 major) Mathemati			
Dachel	or s de	gree (1 major) mathemati	cal Physics (2024)		

Module title Abbreviation					Abbreviation
Introd	uction t	o Discrete Mathematics	for Mathematical Phy	/sics	10-M-DIMP-152-m01
Module coordinator				Module offered by	
Dean of Studies Mathematik (Mathematics)			atics)	Institute of N	Nathematics
ECTS	Meth	od of grading	Only after succ. com	1pl. of module	e(s)
10	nume	rical grade			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conte	nts	·			
		om combinatorics, introd ig codes.	luction to graph theor	ry (including a	applications), cryptographic methods,
Intend	led lear	ning outcomes			
levant	proof te		ly methods from num		discrete mathematics, masters the re- Id algebra to discrete mathematics and
Course	es (type, r	number of weekly contact hours,	language — if other than Ger	rman)	
V (4) +	Ü (2)				
^{module} a) writ	is creditab ten exa	Sessment (type, scope, langua ole for bonus) mination (approx. 90 to 1 nation of one candidate e	80 minutes, usually 0	chosen) or	ed — if not every semester, information on whether
c) oral Langu	examin	ation in groups (groups o ssessment: German and	of 2, 10 to 15 minutes		e)
Alloca	tion of _l	places	-		
			-		
Additi	onal inf	ormation			
	_				
Workl	oad				
300 h					
Teach	ing cycl	e			
Referr	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	
		_			
Modu	e appea	ars in			
Bache	Bachelor's degree (1 major) Mathematical Physics (2015)				
		gree (1 major) Mathemat gree (1 major) Mathemat			
Bache Bache	lor's de lor's de		ical Physics (2016) ical Physics (2020)		

Module title Abbreviation					Abbreviation
Introduction to Projective Geometry for Mathematical Phys			r Mathematical Phys	ics	10-M-PGEP-152-m01
Modul	e coord	inator		Module offered by	
		es Mathematik (Mathema	atics)	Institute of Mather	
ECTS	1	od of grading	Only after succ. con	npl. of module(s)	
10		rical grade			
Duratio		Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts		_		
		l affine planes, projective s, dualities and polarities			es, fundamental theorems for pro-
Intend	ed lear	ning outcomes			
		acquainted with the fun ethods to practical probl		nd methods of proje	ective geometry. He/she is able to
Course	es (type, i	number of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
		sessment (type, scope, langua ole for bonus)	ge — if other than German, o	examination offered — if n	ot every semester, information on whether
c) oral Langua Assess	examir age of a	nation of one candidate e nation in groups (groups o ssessment: German and, ffered: In the semester in bonus	of 2, 10 to 15 minutes /or English	per candidate)	ubsequent semester
	tion of				
Additio	onal inf	ormation			
	-				
Worklo	bad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	
Modul	e appea	ars in			
		gree (1 major) Mathemati	• •		
		gree (1 major) Mathemati	•		
		gree (1 major) Mathemati	•		
васпе	ior's de	gree (1 major) Mathemati	cai Physics (2024)		

Module title				Abbreviation	
Introduction to Number Theory for Mathematical Physics			hematical Physics		10-M-ZTHP-152-m01
Module	e coord	inator		Module offered by	
Dean of	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio		Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
tests ar	nd met		ructure of the residue	class rings, theory	ation, modular arithmetics, prime of quadratic remainder, quadratic
Intende	ed lear	ning outcomes			
		acquainted with the fun methods and proof tech			ber theory. He/she is able to em-
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)	
V (4) +	Ü (2)				
a) writte b) oral c) oral e	ereditab en exal examir examin ge of a	le for bonus) mination (approx. 90 to 1 nation of one candidate e nation in groups (groups c ssessment: German and,	80 minutes, usually ach (15 to 30 minutes of 2, 10 to 15 minutes	chosen) or s) or	ot every semester, information on whether
Allocat					
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachir	ng cycl	e			
			,		
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	immes)	
			- · · •		
Module	appea	ars in			
		gree (1 major) Mathemati	cal Physics (2015)		
		gree (1 major) Mathemati	,		
		gree (1 major) Mathemati			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)		

Module title Abbreviation					Abbreviation
Operat	Operations Research for Mathematical Physics				10-M-ORSP-152-m01
Module coordinator				Module offered by	
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mather	
ECTS	CTS Method of grading Only after succ.		Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts				
Linear	prograi	nming, duality theory, tra	insport problems, int	egral linear program	nming, graph theoretic problems.
Intend	ed lear	ning outcomes			
for solv	ving ma		pecially in economic		h, as required as a central tool apply these methods to practical
Course	es (type, 1	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V (4) +	Ü (2)				
		sessment (type, scope, langua ole for bonus)	ge — if other than German, o	examination offered — if n	ot every semester, information on whether
b) oral c) oral Langua Assess	examir examir age of a	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups o ssessment: German and, ffered: In the semester in bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes /or English	5) or per candidate)	ubsequent semester
Alloca	tion of	places			
Additio	onal inf	ormation			
Worklo	bad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	
Modul	e appea	ars in			
		gree (1 major) Mathemati			
		gree (1 major) Mathemati	, , ,		
васне	ior's de	gree (1 major) Mathemati	cal Physics (2020)		

Module	e title				Abbreviation
Introdu	iction t	o Differential Geometry f	or Mathematical Phy	sics	10-M-DGEP-152-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. com	pl. of module(s)	
10	numerical grade				
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts		L		
particu	lar) in I		ure of hypersurfaces,		bmanifolds (hypersurfaces in es, main theorem on local sur-
Intende	ed lear	ning outcomes			
					erential geometry. He/She is ac- ental proof methods indepen-
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
		sessment (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether
Assess may on den (O themat Langua	ment w ly be s verview ics). ge of a ment o	elected as the subject of / Mathematical Methods) ssessment: German and, ffered: In the semester in	pic in pure mathemat one examination in t or in module group E /or English	ics as agreed upon he sub-field Gesamt Ergänzung Mathema	with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma- ubsequent semester
Allocat	ion of _l	olaces			
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
Bachel	or's de	gree (1 major) Mathemati	• -		
		gree (1 major) Mathemati			
		gree (1 major) Mathemati gree (1 major) Mathemati	•		
Datilel		Biee (I majoi) maliieniali	cai filysics (2024)		

Module	e title				Abbreviation
Ordina	ry Diffe	rential Equations for M	athematical Physics		10-M-DGLP-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathen	natics
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)	
10	nume	rical grade			
Duratio	n	Module level	Other prerequisites	6	
1 seme	ster	undergraduate			
Conten	ts				
		uniqueness theorem; (tions; matrix exponenti			tial values; systems of linear dif- igher order.
Intende	ed lear	ning outcomes			
		acquainted with the fu /she is able to apply th			heory of ordinary differential
Course	S (type, r	umber of weekly contact hours	s, language — if other than Ge	rman)	
V (4) +	Ü (2)				
a) oral b) oral Assess may on den (Ov themat	examin examir ment w ly be s verview ics). ge of a ble for	le for bonus) ation of one candidate ation in groups of 2 ca ill have reference to a t elected as the subject o Mathematical Method ssessment: German an bonus	each (15 to 30 minute ndidates (10 to 15 min opic in pure mathema of one examination in t s) or in module group	s) or utes each) tics as agreed upon the sub-field Gesamt	ot every semester, information on whether with the examiner. Each topic tüberblick Mathematische Metho tik (Supplementary Topics in Ma-
		haces			
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	d to in	LPOI (examination regulation	ons for teaching-degree progr	ammes)	
Module	e appea	in and a second s			
Bachel Bachel	or's de or's de	gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Mathema	atical Physics (2016) atical Physics (2020)		

Module title					Abbreviation
Introdu	uction t	o Complex Analysis for	Mathematical Physic	S	10-M-FTHP-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mather	natics
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)	
10		rical grade		•	
Duratio		Module level	Other prerequisites	5	
1 seme	ster	undergraduate			
Conten					
rems, i	solated		rphic functions and La	urent series, residue	grals and Cauchy integral theo- e theorem and applications, Wei
Intend	ed lear	ning outcomes			
		acquainted with the fu ethods to practical pro		and methods in com	plex analysis. He/she is able to
Course	S (type, r	number of weekly contact hours	s, language — if other than Ge	rman)	
V (4) +	Ü (2)				
		Sessment (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if n	ot every semester, information on whether
			ndidates (10 to 15 min	utes each)	
may on den (O ^v themat Langua	nly be s verview tics). age of a	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	
may on den (Ov themat	nly be s verview tics). age of a ble for	vill have reference to a t elected as the subject o Mathematical Method ssessment: German an bonus	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Metho
may on den (O themat Langua credita	nly be s verview tics). age of a ble for	vill have reference to a t elected as the subject o Mathematical Method ssessment: German an bonus	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	with the examiner. Each topic tüberblick Mathematische Metho tik (Supplementary Topics in Ma
may on den (Ov themat Langua credita Allocat	nly be s verview tics). age of a ble for tion of j	vill have reference to a t elected as the subject o Mathematical Method ssessment: German an bonus	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Meth
may on den (O themat Langua credita Allocat Additio	nly be s verview tics). age of a ble for tion of j	vill have reference to a t elected as the subject o v Mathematical Method ssessment: German an bonus blaces	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Additio	ily be s verview tics). age of a ble for tion of p	vill have reference to a t elected as the subject o v Mathematical Method ssessment: German an bonus blaces	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Metho
may on den (O themat Langua credita Allocat Additio Worklo	ily be s verview tics). age of a ble for tion of p	vill have reference to a t elected as the subject o v Mathematical Method ssessment: German an bonus blaces	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Metho
may on den (O' themat Langua credita Allocat Additio Worklo 300 h	ily be s verview tics). age of a ble for tion of p onal inf	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus blaces ormation	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Metho
may on den (O' themat Langua credita Allocat Additio Worklo 300 h	ily be s verview tics). age of a ble for tion of p onal inf	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus blaces ormation	opic in pure mathema of one examination in t s) or in module group	tics as agreed upon the sub-field Gesam	tüberblick Mathematische Metho
may on den (O' themat Langua credita Allocat Morklo 300 h Teachin 	nly be s verview tics). age of a ble for tion of p onal inf pad	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus blaces ormation	opic in pure mathema of one examination in t s) or in module group d/or English	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Morklo 300 h Teachin 	nly be s verview tics). age of a ble for tion of p onal inf pad	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus blaces ormation	opic in pure mathema of one examination in t s) or in module group d/or English	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Worklo 300 h Teachin Referre	nly be s verview tics). age of a ble for ion of p onal inf oad ng cycl	vill have reference to a t elected as the subject of mathematical Method ssessment: German an bonus places ormation e LPOI (examination regulation	opic in pure mathema of one examination in t s) or in module group d/or English	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Additio 300 h Teachin Referre Module	nly be s verview tics). age of a ble for tion of p onal inf pad	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus olaces ormation e LPO I (examination regulation ars in	opic in pure mathema of one examination in t s) or in module group d/or English	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Worklo 300 h Teachin Referre Bachel	Ily be s verview tics). age of a ble for ion of p onal inf oad ad ed to in e appea or's de	vill have reference to a t elected as the subject of mathematical Method ssessment: German an bonus places ormation e LPOI (examination regulation	tical Physics (2015)	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth
may on den (O' themat Langua credita Allocat Worklo 300 h Teachi Referre Bachel Bachel	nly be s verview tics). age of a ble for ion of p onal inf pad ng cycl ed to in e appea or's de or's de	vill have reference to a t elected as the subject of Mathematical Method ssessment: German an bonus olaces ormation e LPO I (examination regulation ars in gree (1 major) Mathematical Mathematical Method ars in Mathematical Method Mathematical Method ars in Mathematical Method Mathematical Method Mathematical Method	opic in pure mathema of one examination in t s) or in module group d/or English	tics as agreed upon the sub-field Gesam Ergänzung Mathema	tüberblick Mathematische Meth

Module	e title				Abbreviation
Geome	etric Ana	alysis for Mathematical	Physics		10-M-GANP-152-m01
Module	e coord	inator		Module offered by	
Dean o	of Studio	es Mathematik (Mathem	atics)	Institute of Mathem	natics
ECTS Method of grading Only after succ. compl. of module(s)					
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	Its		-		
		in analysis on manifold tor analysis and topolog		ulus of differential f	orms, Stoke's theorem and appli-
Intend	ed lear	ning outcomes			
		acquainted with the fun ethods to practical prob		nd methods in geom	netric analysis. He/she is able to
Course	S (type, r	umber of weekly contact hours,	language — if other than Ge	rman)	
V (4) +	Ü (2)				
		essment (type, scope, langua le for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether
may or den (O themat Langua	nly be soverview tics).	elected as the subject of Mathematical Methods ssessment: German and	one examination in t) or in module group	he sub-field Gesamt	with the examiner. Each topic überblick Mathematische Metho tik (Supplementary Topics in Ma-
	tion of p				
			-		
Additio	onal inf	ormation	_		
			_		
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	ammes)	
Module	e appea	in in			
Bachel Bachel	or's de or's de	gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Mathemat gree (1 major) Mathemat	ical Physics (2016) ical Physics (2020)		

Module	e title				Abbreviation	
Introdu	uction t	o Functional Analysis f	or Mathematical Physi	ics	10-M-FANP-152-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathe	matics)	Institute of Mather	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade		-		
Duratio	•	Module level	Other prerequisites	j		
1 seme	ster	undergraduate				
Conten	ts	5	I			
		s and Hilbert spaces, b	oounded operators, pri	nciples of functiona	analysis.	
		ning outcomes	<u> </u>			
method broad a	ds, is a applica	ole to apply methods f bility of the theory to o	rom linear algebra and ther branches of mathe	analysis to function ematics.	sis as well as the pertinent proof al analysis, and realises the	
	-	umber of weekly contact hour	s, language — if other than Ge	rman)		
V (4) +	Ü (2)					
Metho	d of ass	essment (type, scope, lang	guage — if other than German,	examination offered — if n	ot every semester, information on whether	
module is	s creditab	le for bonus)				
Assess may on den (Ov themat	ment w nly be s verview tics). age of a	vill have reference to a elected as the subject Mathematical Methoc ssessment: German ar	of one examination in t ls) or in module group	tics as agreed upon he sub-field Gesam	with the examiner. Each topic tüberblick Mathematische Metho atik (Supplementary Topics in Ma	
Allocat	ion of _l	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cvcl	6				
	0.95					
Referre	ed to in	LPOI (examination regulation	ons for teaching-degree progra	ammes)		
Module	annes	ors in				
Racher	51 3 UE	gree (1 maior) Mathem	atical Physics (2015)			
	Bachelor's degree (1 major) Mathematical Physics (2015)					
Bachel			-			

Module	e title				Abbreviation
Introdu	iction t	o Partial Differential Equ	ations for Mathemati	ical Physics	10-M-PARP-152-m01
Module	e coord	inator		Module offered by	
Dean of Studies Mathematik (Mathematics)		Institute of Math	ematics		
ECTS	Meth	od of grading	Only after succ. com	pl. of module(s)	
10	numerical grade				
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts		Į		
	orems	, basic equations of math			f first order, existence and uniquen- olems, maximum principle and Di-
Intend	ed lear	ning outcomes			
		acquainted with the fun is able to apply these me			e theory of partial differential equa-
Course	S (type, 1	number of weekly contact hours, I	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
module is a) oral b) oral	s creditat examir examir	^{ble for bonus)} nation of one candidate e nation in groups of 2 cano	ach (15 to 30 minutes didates (10 to 15 minu	6) or ites each)	f not every semester, information on whether
may on den (Ov themat Langua	ily be s verview ics). ige of a ment o	elected as the subject of v Mathematical Methods) issessment: German and iffered: In the semester ir	one examination in th or in module group E /or English	he sub-field Gesa Ergänzung Mather	mtüberblick Mathematische Metho natik (Supplementary Topics in Ma
Allocat	ion of	places			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
 Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
 Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
			s for teaching-degree progra	mmes)	
 Module	e appea	ars in		mmes)	
 Module Bachel	e appe a or's de		ical Physics (2015)	mmes)	
 Module Bachel Bachel	e appe a or's de or's de	ars in gree (1 major) Mathemati	ical Physics (2015) ical Physics (2016)	mmes)	

Module	e title				Abbreviation
Modeli	ng and	Computational Science			10-M-MWR-152-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. com	npl. of module(s)	
8		rical grade			
Duratio		Module level	Other prerequisites	res	
1 seme		undergraduate			
Conten		undergraduate	L		
scaling ons, fu near ec	the mondame	odelling, asymptotic serie ntal methods for numerio IS.	es, classical methods	for solving ordinary	rinciples of modelling, aspects o and partial differential equati- ns and the resulting systems of l
Intend	ed lear	ning outcomes			
		nasters the fundamental i ng sciences on a comput		ds and techniques to	o simulate processes from natura
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)	
V (4) +	Ü (2)				
Module	e taugh	t in: German and/or Engl	ish		
		5essment (type, scope, langua ble for bonus)	ge — if other than German, e	examination offered — if n	ot every semester, information on whether
b) oral c) oral	examir examin age of a	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups o issessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or	
Allocat	ion of _l	places			
Additio	onal inf	ormation			
Worklo	ad				
240 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
		gree (1 major) Physics (20	-		
Bachelor's degree (1 major) Mathematical Physics (2015)					
	or's do	(') C		245)	
Bachel			onal Mathematics (20	515)	
Bachel Bachel	or's de	gree (1 major) Mathemati	cal Physics (2016)	515)	
Bachel Bachel Master	or's de 's degr	gree (1 major) Mathemati ee (1 major) Functional M	cal Physics (2016) aterials (2016)	J15)	
Bachel Bachel Master Bachel	or's de 's degr or's de	gree (1 major) Mathemati	cal Physics (2016) aterials (2016) 020)	(51	



Module Group Experimental Physics

(ECTS credits)

Module	e title				Abbreviation
Optics	and Wa	aves			11-E-O-152-m01
Module coordinator				Module offered by	
Manag	ing Dir	ector of the Institute of Ap	oplied Physics	Faculty of Physics a	and Astronomy
ECTS	Meth	od of grading	Only after succ. compl. of module(s)		
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 semester undergraduate					
Contents					
					inciple: reflection, refraction. I frequency-dependent dielectric

2. Light in matter: propagation velocity in the medium; dispersion, complex and frequency-dependent dielectric constant; absorption, Kramers-Kronig relation, interfaces, Fresnel equations, polarization, generation by absorption, birefringence, optical activity (dipole)

3. Geometrical optics: basic concepts, Fermat's principle, optical path, planar interfaces, Snell's law, total reflection, optical tunneling, evanescent waves, prism; normal and anomalous dispersion, curved interfaces, thin and thick lenses, lens systems, lens grinder formula, aberrations, imaging errors (spherical & chromatic aberration, astigmatism, coma, distortion, correction approaches).

4. Optical instruments: characteristics; camera, eye, magnifying glass, microscope, telescope types, bundle beam vs. image construction (electron lenses, electron microscope), confocal microscopy.

5. Wave optics: spatial and temporal coherence, Young's double slit experiment, interference pattern (intensity profile), thin films, parallel layers, wedge-shaped layers, phase shift, Newton rings, interferometer (Michelson, Mach-Zender, Fabry-Perot).

6. Diffraction in the far field: Fraunhofer diffraction, , single slit, intensity distribution, apertures, resolving power, Rayleigh & Abbé criterion, Fourier optics, optical grating, n-fold slit, intensity distribution, grating spectrometer and resolution, diffraction off atomic lattices, convolution theorem.

7. Diffraction in the near field: Fresnel, near-field diffraction at circular apertures/disks, Fresnel zone plate, near-field microscopy, holography, Huygens-Fresnel concept; white light hologram.

8. Failure of classical physics I - from light wave to photon: black body radiation and Planck's quantum hypothesis; photoelectric effect and Einstein's explanation, Compton effect, light as a particle, wave-particle duality, , quantum structure of nature

9. Failure of classical physics II - particles as waves: de Broglie's matter wave concept; diffraction of particle waves (Davisson-Germer-experiment, double slit interference).

10. Wave mechanics: wave packets, phase and group velocity (recap of 11-EM), uncertainty principle, Nyquist-Shannon theorem, wave function as probability amplitude, probability of residence, measurement process in quantum mechanics (double-slit experiment & which-way information, collapse of the wave function, Schrödinger's cat).

11. Mathematical concepts of quantum mechanics: Schrödinger equation as wave equation, conceptual comparison to wave optics, free particle and particles in a potential, time-independent Schrödinger equation as eigenvalue equation, simple examples in 1D (potential step, potential barrier and tunnel effect, box potential and energy quantization, harmonic oscillator), box potential in higher dimensions and degeneracy, formal theory of QM (states, operators, observables).

Intended learning outcomes

The students understand the basic principles and contexts of radiation, wave and quantum optics. They understand the theoretical concepts and know the structure and application of important optical instruments and measuring methods. 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.

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

V (4) + Ü (2)

Module taught in: Ü: German or English

Bachelor's with 1 major Mathematical Physics	
(2016)	

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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) Language of assessment: German and/or English
Allocation of places
Additional information
Workload
240 h
Teaching cycle
Referred to in LPO I (examination regulations for teaching-degree programmes)
Module appears in
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020)
Bachelor's degree (1 major) Mathematics (2023)
exchange program Physics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module	e title				Abbreviation	
Atoms	and Qu	ianta			11-E-A-152-m01	
Module	e coord	inator		Module offered by		
Managing Director of the Institute of Ap			oplied Physics	Faculty of Physics and Astronomy		
ECTS	Methe	Method of grading Only aft		npl. of module(s)		
8	nume	rical grade				
Duration Module level		Other prerequisites				
1 semester undergraduate						
Conten	Contents					

 Structure of atoms: Experimental evidence for the existence of atoms, size of the atom, charges and masses in the atom, isotopes, internal structure, Rutherford experiment, instability of the "classical" Rutherford atom.
 Quantum mechanical foundations of Atomic Physics (short recap of part A.): Light as particle beam, particles as waves, wave functions and probability of presence, uncertainty relation and stability of atoms, energy quantisation in atoms, Franck-Hertz experiment, atomic spectra, Bohr's model and its limitations, non-relativistic Schrödinger equation.

3. The non-relativistic hydrogen atom: Hydrogen and hydrogen-like atoms, central potential and angular momentum in QM, Schrödinger equation of the H-atom, atomic orbitals: Radial and angular wave functions, quantum numbers, energy eigenvalues.

4. Atoms in external fields: orbital magnetic dipole moment, gyromagnetic ratio, magentic fields: normal Zeeman effect, electrical fields: Stark effect.

5. Fine and hyperfine structure: Electron spin and magnetic spin moment, Stern-Gerlach experiment, Einstein-de Haas effect, glimpse of the Dirac equation (spin as a relativistic phenomenon and existence of antimatter), electron spin resonance (ESR), spin-orbit interaction, relativistic fine structure, Lamb shift (quantum electrodynamics), nuclear spin and hyperfine structure.

6. Multi-electron atoms: Helium atom as simplest example, indistinguishability of identical particles, (anti)symmetry with respect to particle exchange, fermions and bosons, relation to spin, Pauli principle, orbital and spin wave function of two-particle systems (spin singlets and triplets), LS- and jj-coupling, Periodic Table of the Elements, Aufbau principles and Hund's rules.

7. Light-matter interaction: Time-dependent perturbation theory (Fermi's Golden Rule) and optical transitions, matrix elements and dipole approximation, selection rules and symmetry, line broadening (lifespan, Doppler effect, collision broadening), atomic spectroscopy.

8. Laser: Elementary optical processes (absorption, spontaneous and stimulated emission), stimulated emission as light amplification, Einstein's rate equations, thermal equilibrium, non-equilibrium character of a laser: Rate equations, population inversion and laser condition, basic structure of a laser, optical pumping, 2-, 3- and 4-level lasers, examples (ruby laser, He-Ne laser, semiconductor laser).

9. Inner-shell excitations and X-ray physics: Generation of x-radiation, bremsstrahlung and characteristic spectrum, X-ray emission for elemental analysis (EDX), X-ray absorption and contrast formation in X-ray images, X-ray photoemission, non-radiative Auger processes, synchrotron radiation, application examples.

10. Molecules and chemical bonding: Molecular hydrogen ion (H2+) as simplest example: Rigid molecule approximation and LCAO approach, bonding and anti-bonding molecular orbitals, hydrogen molecule (H2): Molecular orbital vs. Heitler-London approximation, diatomic heteronuclear molecules: covalent vs. ionic bonding, van der Waals bonds and Lennard-Jones potential, (time allowing: conjugated molecules).

11. Molecule rotations and vibrations: Born-Oppenheimer approximation, energy levels of the rigid rotator (symmetric and asymmetrical molecules), centrifugal expansion, molecule as (an)harmonic oscillator, Morse potential, normal modes, vibrational-rotational interaction.

12. Molecular spectroscopy: Transition matrix elements, vibrational spectroscopy: Infrared spectroscopy and Raman effect, vibrational-rotational transitions: Fortrat diagram, electronic transitions: Franck-Condon principle.

Intended learning outcomes

The students understand the basic principles and contexts of quantum phenomena as well as Atomic and Molecular Physics. They understand the ideas and concepts of quantum theory and Astrophysics and the relevant experiments to observe and measure quantum phenomena. They are able to apply mathematical methods to the

Bachelor's with 1 major Mathematical Physics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. da-	page 89 / 147
(2016)	ta record Bachelor (180 ECTS) Mathematische Physik - 2016	

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formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-phys cal tasks.
Courses (type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2) Module taught in: Ü: German or English
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) Language of assessment: German and/or English
Allocation of places
Additional information
Workload
240 h
Teaching cycle
Referred to in LPO I (examination regulations for teaching-degree programmes)
Module appears in
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020)
Bachelor's degree (1 major) Mathematics (2023)
exchange program Physics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title					Abbreviation	
Introdu	iction t	o Solid State Physics	11-E-F-152-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	pl. of module(s)		
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Somme deman 2. Cryst tice def tronic p 3. The r theory: 4. Struc electro 5. lattic branch exampl 6. Ther therma 7. Elect strongl on 8. Supe	erfeld c n-Franz tal stru fects; p properti reciproo Scatte cture de n diffra ce vibra ; quant les of d mal pro l expar rrons in y boun	oefficient; electrons in fie e law; Hall effect; limitatio cture, periodic lattice; typ oolycrystals; amorphous s ies cal lattice (RG), motivatio ring; Ewald construction; etermination, probes: X-r ction, LEED tions (phonons), equatio ispersion curves (occ. Kr operties of insulators, Ein hsion; thermal conductivi a periodic potential, Blo d electrons (tight binding	elds: Drude-Lorentz-Sons of the model bes of lattices; Bravai solids; group theoretion; Bragg Bragg equation; Lau ay, electron, neutron ons of motion; disper- tum; optical properties amers-Kronig), measus stein and Debye moo ty; Umklapp process ch theorem; band str g, LCAO); examples of	sommerfeld; electrica is lattice; Miller indic cal approaches, the condition; definition e's equation; structu ; methods: Laue, Del sion; group velocity; es in the infrared; die urement methods del; phonon density o es; crystal defects ructure; approximatio f band structures, Fe	ermi-Dirac statistics; spec. heat, al and thermal conductivity, Wie- ces; simple crystal structures; lat- importance of symmetry for elec- ; Brillouin zones; diffraction ure and form factor bye-Scherrer, rotating crystal; diatomic base: optical, acoustic electric function (Lorentz model); of states; anharmonicity and on of nearly free electrons (NFE); rmi surfaces, spin-orbit interacti- odes, band structure, many-par-	
Intende	ed lear	ning outcomes				
The stu dynami ture of Solid-S	idents i ics, the solids tate Ph	understand the basic con rmal properties, principle and know the experiment	es of electronic prope tal methods and theo oply mathematical m	erties (free electron g pretical models for th ethods to the formul	es (bonding and structure, lattice (as)). They understand the struc- te description of phenomena of ation of physical contexts and asks.	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) + Module		t in: Ü: German or Englisł	1			
		Sessment (type, scope, langua le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, information on whether	
	written examination (approx. 120 minutes) Language of assessment: German and/or English					
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
240 h			· · · · · · · · · · · · · · · · · · ·			
<u> </u>						

Teaching cycle

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

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Module appears in

Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Physics (2015) Bachelor's degree (1 major) Nanostructure Technology (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Mathematics (2023) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module title					Abbreviation	
Nuclear	and El	ementary Particle Phy	sics		11-E-T-152-m01	
Module	coord	nator		Module offered by		
Managi	ng Dire	ctor of the Institute of	Applied Physics	blied Physics Faculty of Physics and Astronomy		
ECTS	CTS Method of grading Only after succ. compl.			npl. of module(s)		
6	nume	ical grade				
Duration Module level Other p			Other prerequisites			
1 semester undergraduate						
Content	ts					
2. Meth charge 3. Nucle 4. Struct spin-orl 5. Radio 6. Nucle the che 7. Radia duction 8. Instru 9. Elect 10. Stro confine 11. Wea ce, exch	 Overview, historical introduction, history and significance of Nuclear and Particle Physics Methods of Nuclear Physics, scattering and spectroscopy, nuclear radius, composition of matter, mass and charge distribution in the nucleus, the discovery of the proton and neutron Nuclear models, the mass of the atomic nuclei, droplet model, bonding energy, nuclear shell model Structure of cores, angular momentum, spin, parity, mag. and electr. moments, collective excitation forms, spin-orbit interaction Radioactivity and spectroscopy, radioactive decay, natural and civilisational sources of ionising radiation Nuclear energy, nuclear fission, nuclear reactors, nuclear fusion, star power, star development, formation of the chemical elements of hydrogen Radiation and matter, interaction of radiation and matter, Bethe-Bloch formula, photoelectric effect, pair production Instruments, accelerators and detectors Electromagnetic interaction, differential cross section, virtual photons, Feynman graphs, exchange interaction Strong interaction, quarks, gluons, colour and degree of freedom, deep-inelastic electron-proton scattering, confinement, asymptotic freedom, particle zoo, isospin, strangeness, SU (3) symmetry, antiprotons Weak interaction, cracked mirror symmetries, Wu experiment, charge conjugation, time reversal, CP invariance, exchange particles, W and Z, neutrinos, neutrino vibrations Standard model, three families of leptons and quarks, quark-lepton symmetry, Higgs boson, free parameters 					
The stu They ha	dents u ive an o	inderstand the basic c	onnections between fu nental observations of			
scribe t						
		umber of weekly contact hour	s, language — if other than Ge	rman)		
	taugh	: in: Ü: German or Engl				
		essment (type, scope, lang e for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
		ation (approx. 120 min ssessment: German ar				
Allocati	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
180 h	180 h					
Teachin	Teaching cycle					
Referre	d to in	LPOI (examination regulati	ons for teaching-degree progra	immes)		
Bachelor's v (2016)	with 1 maj	or Mathematical Physics	-	generated 19-Apr-2025 • exa r (180 ECTS) Mathematische I	-	page 93 / 147

Module appears in

Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (2020) Bachelor's degree (1 major, 2020) Bachelor's degree (1 major) Mathematics (2023) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)



Module Group Supplementary Topics in Physics

(ECTS credits)

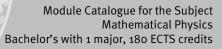
Module	e title				Abbreviation		
Group	Theory				11-GRT-152-m01		
Module	e coord	inator		Module offered by	1		
Manag	Managing Director of the Institute of Theoretical Physics and Astrophysics			Faculty of Physics a	and Astronomy		
ECTS		od of grading	Only after succ. cor	Only after succ. compl. of module(s)			
6	1	rical grade					
Duratio		Module level	Other prerequisites	6			
1 seme	ster	graduate					
Conten	ts	5					
		Finite groups. Lie grou	ns. Lie algebra. Depicti	ion. Tensors. Classifi	cation theorem. Apr	olications.	
		ning outcomes					
group t	heory a	know the basics of grou and to solve them by us cessing of physical pro	sing the acquired meth				
Course	S (type, r	umber of weekly contact hour	s, language — if other than Ge	rman)			
V (2) + Module		t in: German or English					
Metho	d of ass	s essment (type, scope, lang	guage — if other than German,	examination offered — if no	ot every semester, informa	tion on whether	
module is	s creditab	le for bonus)					
If a writ stead t of asse nation	tten exa ake the ssmen date at ge of a	n/talk (approx. 30 min amination was chosen form of an oral examin t is changed, the lectur the latest. ssessment: German ar	as method of assessm nation of one candidat er must inform studen	e each or an oral exa	mination in groups.	If the method	
Additio	nal inf	ormation					
Worklo	ad						
180 h							
Teachi	ng cycl	2					
	is eyer	-					
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	ammes)			
Module							
Bachel	or's de	gree (1 major) Physics (gree (1 major) Mathema	atical Physics (2015)				
		gree (1 major) Mathema gree (1 major) Physics (•				
		gree (1 major) Mathema					
		gram Physics (2023)	, ()				
	with 1 ma	or Mathematical Physics	-	• generated 19-Apr-2025 • ex	-	page 96 / 147	
2016)			ta record Bachelo	or (180 ECTS) Mathematische	Physik - 2016		



Bachelor's degree (1 major) Mathematical Physics (2024)

Module title					Abbreviation	
Comput	tationa	l Physics		11-CP-152-m01		
Module	coord	inator		Module offered by		
Managi and Ast		ector of the Institute of T sics	heoretical 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	5		
1 seme	ster	undergraduate				
Conten	ts					
• n • si • g • ra	umeric imulati enerati andom	tion to programming or al solution of differentia on of chaotic systems on of random numbers walk article processes and re	al equations			
Intende	ed leari	ning outcomes				
They ha	ive kno	nave knowledge of two i wledge of numerical sta ysical problems, e.g. alg	andard methods and a	are able to apply com	puter-assisted proc	
Course	5 (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (3) + I Module		t in: German or English				
Method	l of ass	sessment (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	ion on whether
·		le for bonus)				
b) oral e c) oral e d) proje If a writ stead ta of asse nation e Langua	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: Once a year, winter semester 					
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teaching cycle						
Referre	d to in	LPO I (examination regulatio	ns for teaching-degree progra	ammes)		
Module						
Bachelo	or's de	gree (1 major) Physics (2	2015)			
Bachelor's ((2016)	with 1 maj	or Mathematical Physics		• generated 19-Apr-2025 • exa or (180 ECTS) Mathematische		page 98 / 147

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Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module title					Abbreviation	
Statist	Statistics, Data Analysis and Computer Physics 11-SDC-152-mo1					
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of A	pplied Physics	Faculty of Physics a	nd Astronomy	
			Only after succ. con	· · ·	,	
4	1	rical grade				
Duratio		Module level	Other prerequisites			
	1 semester graduate					
		giauuale	[
-	Contents					
		a analysis and computer	pnysics.			
	-	ning outcomes				
The stu Physics		have specific and advanc	ced knowledge in the	field of statistics, da	ta analysis and Corr	ıputational
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)		
V (2) +	R (1)					
Module	e taugh	t in: German or English				
		5essment (type, scope, langua ole for bonus)	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
c) oral d d) proje e) pres lf a writ stead t of asse nation Langua Assess Allocat Additio 120 h	a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: German and/or English Assessment offered: Once a year, winter semester Allocation of places Mdditional information 					
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	immes)		
Module appears in						
Module appears in Bachelor's degree (1 major) Physics (2015) Bachelor's degree (1 major) Nanostructure Technology (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelor's (2016)	with 1 ma	jor Mathematical Physics		generated 19-Apr-2025 • exa r (180 ECTS) Mathematische F	-	page 100 / 147



Bachelor's degree (1 major) Quantum Technology (2021) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module	title		Abbreviation					
Astrophysics 11-AP-152-m01								
Module	coord	inator		Module offered by	Module offered by			
Managi and Ast	-	ector of the Institute of T sics	heoretical Physics	Faculty of Physics a	nd Astronomy			
ECTS	Metho	od of grading	Only after succ. compl. of module(s)					
6	nume	rical grade						
Duratio	n	Module level	Other prerequisites	Other prerequisites				
1 semes	ster	undergraduate						
Conten	ts							
telesco um, mo lactic n	pes an leculai uclei, l	onomy, coordinates and d detectors, stellar struc r clouds, structure of the arge-scale structures, co	cture and atmosphere milky way, the local	s, stellar evolution a	nd end stages, inter	stellar medi-		
Intende	d lear	ning 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 are familiar with the physics and development of the main astrophysical objects such as stars and ga- laxies.								
Courses	5 (type, n	umber of weekly contact hours,	language — if other than Ge	rman)				
V (2) + I Module		t in: German or English						
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 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English 								
Allocation of places								
Additional information								
Workload 180 h								
Teaching cycle								
Referred to in LPO I (examination regulations for teaching-degree programmes)								
§ 22 Nr. 1 h) § 22 Nr. 2 f) § 22 Nr. 3 f)								
Module		irs in						
		or Mathematical Physics	IMU Würzburg •	generated 19-Apr-2025 • exa	am. reg. da-	page 102 / 147		
(2016)	-,			r (180 ECTS) Mathematische				

UNIVERSITÄT WÜRZBURG

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

Module	e title			Abbreviation				
Particle Physics (Standard Model)					11-TPS-152-m01			
Module coordinator				Module offered by				
Managing Directors of the Institute of Applied Physics and				Faculty of Physics and Astronomy				
		f Theoretical Physics an						
ECTS	Meth	od of grading	Only after succ. con	Only after succ. compl. of module(s)				
8	nume	rical grade						
Duratio	on	Module level	Other prerequisites					
1 seme	ester	undergraduate						
Conten	nts							
Electro parity \ Bhabha Z-Line Higgs p Experir ters	weak s Violatio a scatte Shape product mental	ering and forward / reverse as ion and decay setup and results of key	gh the Higgs mechani symmetry		nd for determining its parame-			
Search	for the	Higgs boson						
		ning outcomes			article Physics and the key ex-			
theoret Course V (4) + Module	tical res s (type, r R (2) e taugh	sults in the framework o number of weekly contact hours, t in: German or English	f the standard model a language — if other than Ge	and know its validity				
		Sessment (type, scope, langu ole for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether			
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Additional information								
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240 h		e						
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240 h Teachi 	ng cycl		ns for teaching-degree progra	ammes)				
240 h Teachi 	ng cycl	e LPOI (examination regulatio	ns for teaching-degree progra	ammes)				
240 h Teachi Referre	ng cycl ed to in			ammes) 9 generated 19-Apr-2025 • exa	am. reg. da- page 104 / 147			

Module appears in

Bachelor's degree (1 major) Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2024)

 and the theory of general relativity, viewing both of them as gauge theories. Application of the theory to simple models of stellar equilibrium. First contact with elements of cosmology. Courses (type, number of weekly contact hours, language – if other than German) V (3) + R (1) Module taught in: German or English Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 	Module title				Abbreviation		
Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy Adtstrophysics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module levet Other prerequisites 1 semester undergraduate Contents Mathematical Foundations Differential geometry Electrodynamics as an example of a relativistic gauge theory Field equations of the fundamental structure of general relativity Stellar equilibrium and other astrophysical applications Intended learning outcomes Familiarity between electrodynamics as an example of a relativity ing both of them as gauge theories. Application of the theory to simpli models of stellar equilibrium. First contact with elements of cosmology. Courses (type, number of weekly contact hours, language – if other than Geman) V (3) + R (1) Module taught in: German or English Method of assessment (type, scope, language – if other than Geman) V (3) + R (1) Module (approx. 30 to 120 minutes) or 0 0 and examination (approx. 90 to 120 minutes) or 0 0 0 and examination in groups (groups of 2, approx. 30 minutes) or 0 0 0 and examination of an examination of assessment, th	Theory of Rel	ativity			11-RTTB-232-m01		
and Astrophysics Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester undergraduate Contents Mathematical Foundations Differential forms Bifferential forms Bifferential forms Bifferential forms Bifferential forms general relativity Electrodynamics as an example of a relativistic gauge theory Field equations of the fundamental structure of general relativity Stellar equilibrium and other astrophysical applications Introduction to cosmology Intended learning outcomes Earniliarity with the basic physical and mathematical concepts of general relativity. Mathematical understandi of the formulation in terms of differential forms. Understanding of the formal similarity between electrodynami and the theory of general relativity, viewing both of them as gauge theories. Application of the theory to simple models of stellar equilibrium. First contact with elements of cosmology. V (3) + R (1) Module taught in: German or English Method of assessment (type, scope, language – if other than Geman, examination offered – if not every senester, information on whethe module is cellable for bonus) a) written examination of one candidate each (approx. 30 minutes) or o) oral examination in groups (Grups of 2, approx. 30 minutes) or o) oral examination in groups. If the method of assessment, this	Module coord	linator		Module offered by	<u>.</u>		
6 numerical grade			neoretical Physics				
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Additional information Approval from examination committee required Workload 180 h							
Approval from examination committee required Workload 180 h	Allocation of places						
Approval from examination committee required Workload 180 h							
Workload 180 h							
180 h							

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

Module appears in

Bachelor's degree (1 major) Physics (2015)

Bachelor's degree (1 major) Mathematical Physics (2015)

Bachelor's degree (1 major) Mathematical Physics (2016)

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

Bachelor's degree (1 major) Mathematical Physics (2020)

exchange program Physics (2023)

Bachelor's degree (1 major) Mathematical Physics (2024)



Module Group Current Topics in Mathematical Physics

(ECTS credits)

Module title					Abbreviation
Curren	t Topics	s in Mathematical Physic	 CS		11-BXMP5-152-m01
Modul	e coord	inator		Module offered by	l
chairperson of examination committee Mathematische Physik (Mathematical Physics)		e Mathematische	Faculty of Physics a	and Astronomy	
ECTS	ECTS Method of grading Only after succ.		Only after succ. con	npl. of module(s)	
5 numerical grade					
Duration Module level Other prerequisites					
1 semester undergraduate Approval from examination committee required.		equired.			
Conter			<u> </u>		
Curren			s. Accredited academ	ic achievements, e.g	g. in case of change of university
Intend	ed lear	ning outcomes			
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Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	ammes)	
 Modula	e annes	urs in			
	e appea or's de		ical Physics (2015)		
Bachel	or's de	gree (1 major) Mathemat			
Bachel Bachel	or's de or's de		ical Physics (2016)		

	Module title				Abbreviation	
Current Topics in Mathematical Physics			cs		11-BXMP6-152-m01	
Module coordinator				Module offered by	Module offered by	
•		f examination committee ematical Physics)	e Mathematische	Faculty of Physics a	and Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade		-		
Duration Module level Other prerequisites						
1 seme	ester			equired.		
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Module title					Abbreviation
Curren	t Topic	s in Mathematical Physi	ics		11-BXMP8-152-m01
Modul	e coord	inator		Module offered by	l
chairperson of examination committee Mathematische Physik (Mathematical Physics)		e Mathematische	Faculty of Physics a	and Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade		-	
Duration Module level Other prerequisites					
1 seme	ester			equired.	
Conter	nts				1
	t topics ly abroa		cs. Accredited academ	ic achievements, e.g	g. in case of change of university
Intend	ed lear	ning outcomes			
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V (4) +	_				
		Sessment (type, scope, langu ole for bonus)	age — if other than German,	examination offered — if no	ot every semester, information on whether
or oral pages) If a wri stead t of asse nation	examir or pres tten exa take the essmen date at	nation in groups (groups sentation/talk (approx. amination was chosen a e form of an oral examin	of 2, approx. 30 minu 30 minutes). 15 method of assessm ation of one candidate er must inform student	ites per candidate) o ent, this may be cha e each or an oral exa	didate each (approx. 30 minutes) or project report (approx. 8 to 10 nged and assessment may in- mination in groups. If the method weeks prior to the original exami
Allocat	tion of _l	places			
Additio	onal inf	ormation			
Worklo	bad				
240 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulatio	ns for teaching-degree progra	ammes)	
		-			
Modul	e appea	ars in			
		gree (1 major) Mathema	tical Physics (2015)		
		• • • •			
Bachel	ul suc	gree (1 major) Mathema	tical Physics (2016)		
		gree (1 major) Mathema gree (1 major) Mathema	· · ·		



Key Skills Area (20 ECTS credits)



General Key Skills

(5 ECTS credits)

In addition to the modules listed below, students may also take modules offered by JMU as part of the pool of general transferable skills (ASQ).



General Key Skills (subject-specific)

(ECTS credits)

Module	e title				Abbreviation	
Exercis	se tutor	or proof-reading in Ma	thematics		10-M-TuKo-152-mo:	L
Module	e coord	inator		Module offered by		
		es Mathematik (Mather	matics)	Institute of Mathem	natics	
ECTS	1	od of grading	Only after succ. con			
5		successfully completed				
Duratio		Module level	Other prerequisites			
1 seme		undergraduate				
Conten						
		ading homework for on	e of the basic courses i	n the Bachelor's or t	eaching degree prog	rammes un-
		on of the respective lect				
Intend	ed lear	ning outcomes				
The stu	udent is	able to support the ac	quisition of mathemati	cal skills and knowle	edge. He/She helps	to identify
mistak	es in m	athematical proof exer	cises and to find possi	ble solutions.		
Course	S (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
T (o)						
Metho	d of ass	Sessment (type, scope, lang	uage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether
	-	le for bonus)				
		f tutoring activities or c		ervising lecturers or e	exercise supervisors	(1 to 2 tea-
		approx. 5 pieces of cor				
Allocat		Diaces				
	_	ormation		/		
		application to teaching	coordinator Mathemat	ics, ne/sne will sele	ct participants.	
Worklo						
150 h						
Teachi	ng cycl	e				
		LPO I (examination regulation	ons for teaching-degree progra	immes)		
§ 22						
Module						
		gree (1 major) Mathema				
		gree (1 major) Economa				
		gree (1 major) Mathema		045)		
		gree (1 major) Computa mination for the teachi		-		
				Mathematics (2015)		
Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Economathematics (2017)						
		mination for the teachi		Mathematics (2019)		
		gree (1 major) Mathema				
		gree (1 major) Economa	•			
		gree (1 major) Economa				
Bachel	or's de	gree (1 major) Mathema	atical Data Science (20	22)		
		gram Mathematics (202				
		mination for the teachi		Mathematics (2023)		
Bachel	or's de	gree (1 major) Mathema	atics (2023)			
	with 1 ma	jor Mathematical Physics	-	generated 19-Apr-2025 • exa	-	page 115 / 147
(2016)			ta record Bachelo	r (180 ECTS) Mathematische	PTIYSIK - 2016	

Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Economathematics (2025)

Module	e title				Abbreviation	
E-Learning and Blended Learning Mathematics 1			thematics 1		10-M-VHB1-152-mo	1
Module coordinator Mo			Module offered by			
		es Mathematik (Mathen	natics)	Institute of Mathem	natics	
			Only after succ. com			
2 Duratia		successfully completed Module level				
Duratio		-	Other prerequisites			
	1 semester undergraduate					
Conten						
Becom	ing fam	niliar with and reflecting	techniques in e-learni	ng and blended lear	ming in mathematics	5.
Intende	ed lear	ning outcomes				
The stu	dent is	able to employ basic m	nethods of e-learning a	nd blended learning	g in mathematics-	
Course	S (type, r	number of weekly contact hours	, language — if other than Ger	man)		
Ü (2)						
• •	type: e	Learning, mostly Virtue	lle Hochschule Bayern	(vhb)		
Metho	d of ass	sessment (type, scope, langu	lage — if other than German.	examination offered — if no	ot everv semester, informati	on on whether
		le for bonus)	,		,,	
project	(web-b	based, 15 to 20 hours)				
		ffered: Once a year, win	ter semester			
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
, la altro						
Worklo						
	au					
60 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)		
Module	e appea	ars in				
		gree (1 major) Mathema	tics (2015)			
		gree (1 major) Economa				
Bachelor's degree (1 major) Mathematical Physics (2015)						
Bachelor's degree (1 major) Computational Mathematics (2015)						
Bachelor's degree (1 major) Mathematical Physics (2016)						
Bachelor's degree (1 major) Economathematics (2017)						
Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelor's degree (1 major) Economathematics (2021) Bachelor's degree (1 major) Economathematics (2022)						
Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Mathematical Data Science (2022)						
Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023)						
		gree (1 major) Mathema	-			
		gree (1 major) Economa	-			
		gree (1 major) Mathema				
		gree (1 major) Economa				
Bachel	or's de	gree (1 major) Economa	thematics (2025)			
	with 1 ma	jor Mathematical Physics	-	generated 19-Apr-2025 • exa	-	page 117 / 147
2016)			ta record Bachelo	r (180 ECTS) Mathematische	Physik - 2016	

Module	e title				Abbreviation	
E-Learr	ning an	d Blended Learning Mat	hematics 2		10-M-VHB2-152-m01	
Module	e coord	inator		Module offered by		
		es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS		od of grading	Only after succ. con			
2		successfully completed				
Duratio		Module level	Other prerequisites			
1 seme		undergraduate				
Conten		undergraduate				
	-	ilion with and reflecting	tashniquas in a laarni	ing and blandad lags	ming in mathematics	
		niliar with and reflecting	techniques in e-learni	ing and blended lear	ming in mathematics.	
	-	ning outcomes				
The stu	ident is	able to employ advance	ed methods of e-learn	ing and blended lea	rning in mathematics-	
	S (type, r	number of weekly contact hours,	language — if other than Ger	rman)		
Ü (2)						
		Learning, mostly Virtuel				
			age — if other than German, o	examination offered — if no	ot every semester, information or	ו whether
		le for bonus)	_			
		based, 15 to 20 hours)				
		ffered: Once a year, sum	imer semester			
Allocat	ion of p	olaces	_			
Additio	onal inf	ormation	_			
Worklo	ad					
60 h						
Teachi	ng cycl	e				
		-				
Deferre				<u>```</u>		
Referre		LPO I (examination regulation	ns for teaching-degree progra	immes)		
Module						
		gree (1 major) Mathemat				
		gree (1 major) Economat	-			
		gree (1 major) Mathemat gree (1 major) Computat	• •	71 E)		
				512)		
Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Economathematics (2017)						
Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelor's degree (1 major) Economathematics (2021)						
Bachelor's degree (1 major) Economathematics (2022)						
		gree (1 major) Mathemat		22)		
		gram Mathematics (202				
		gree (1 major) Mathemat	-			
		gree (1 major) Economat				
		gree (1 major) Mathemat gree (1 major) Economat				
		gree (1 major) Economat gree (1 major) Economat				
		jor Mathematical Physics		generated 19-Apr-2025 • exa	am reg da.	ge 118 / 147
(2016)	with T IIId	jor mathematical FilySiCS	-	r (180 ECTS) Mathematische		50 110 / 14/

Module	title			-	Abbreviation	
Preparatory Course Mathematics					11-P-VKM-152-m01	
		• ,				
Module				Module offered by		
		ectors of the Institute o f Theoretical Physics ar		Faculty of Physics a	ind Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
2	(not) s	successfully completed				
Duratio	n	Module level	Other prerequisites	i		
1 seme	ster	undergraduate				
Conten	ts					
the intr 1. Basic 2. Coor 3. Vecto	oductio geom dinate ors - ve rential	nathematics and eleme on to and preparation f etry and algebra systems and complex r ctored values calculus culus	or the modules of Expe			specially for
		ning outcomes				
		now the principles of r	nathematics and elem	entary calculation m	ethods which are re	auired for
		tudying Theoretical and			ethous which are re	quirea ioi
Course	S (type, n	umber of weekly contact hour	5, language — if other than Ge	rman)		
T (2)						
a) exero b) talk	creditab cises (s (approx	essment (type, scope, lang le for bonus) successful completion (k. 15 minutes) ffered: Once a year, wil	of approx. 50% of appr			ion on whether
Allocat						
Additio	nal inf	ormation				
	natini					
Worklo	2d					
60 h	au					
Teachir	ng evel	0				
reaciiii	יא נאנו	6				
 Deferm	a 6			`		
§ 22 § 22 § 22 § 22 § 22	Nr. 1 h) Nr. 2 f)	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Module	appea	irs in				
Bachelo Bachelo Bachelo First sta First sta	or's de or's de or's de ate exa ate exa	gree (1 major) Physics (gree (1 major) Nanostru gree (1 major) Mathema gree (1 major, 1 minor) mination for the teachi mination for the teachi mination for the teachi	acture Technology (201 atical Physics (2015) Physics (Minor, 2015) ng degree Grundschule ng degree Grundschule	e Physics (2015) e Didactics in Physics	s (Primary School) (2	2015)
		or Mathematical Physics		generated 19-Apr-2025 • exa	am. reg. da-	page 119 / 147
(2016)		S. Mathematicat i nysics		or (180 ECTS) Mathematische	•	Puse 119 / 14/

First state examination for the teaching degree Gymnasium Physics (2015) First state examination for the teaching degree Sonderpädagogik Didactics in Physics (Middle School) (2015) First state examination for the teaching degree Mittelschule Physics (2015) First state examination for the teaching degree Mittelschule Didactics in Physics (Middle School) (2015) Bachelor's degree (1 major) Mathematical Physics (2016)

First state examination for the teaching degree Grundschule Physics (2018)

First state examination for the teaching degree Grundschule Didactics in Physics (Primary School) (2018)

First state examination for the teaching degree Realschule Physics (2018)

First state examination for the teaching degree Gymnasium Physics (2018)

First state examination for the teaching degree Mittelschule Physics (2018)

First state examination for the teaching degree Sonderpädagogik Didactics in Physics (Middle School) (2018) First state examination for the teaching degree Mittelschule Didactics in Physics (Middle School) (2018)



Subject-specific Key Skills

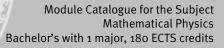
(15 ECTS credits)



Compulsory Courses

(9 ECTS credits)

Module	title				Abbreviation	
Basic N	otions	and Methods of Mathe	matical Reasoning		10-M-GBM-152-mo1	
Module	coord	inator		Module offered by		
Dean of	fStudie	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS						
2	·	successfully completed				
Duratio		Module level	Other prerequisites			
1 semes		undergraduate				
Conten	ts	0	1			
Introdu	ction to	the basic notions and	proof techniques in m	athematics: approa	ch to sets, formal log	gic and maps
		ning outcomes	·			5 1
		ets acquainted with the	basic working technig	ues which are prere	auisites for the furth	er courses in
		degree study program				
Courses	S (type, n	umber of weekly contact hours,	language — if other than Ger	rman)		
V (1) + Ü	Ü (1)					
		essment (type, scope, langu le for bonus)	age — if other than German, e	examination offered — if no	ot every semester, informat	ion on whether
project	(10 to :	15 pages)				
Langua	ge of a	ssessment: German and	l/or English			
Allocati	ion of p	olaces				
			_			
Additio	nal info	ormation				
Additio	nal info	ormation on module dur	ation: block taught pr	ior to the beginning	of the lecture period	•
Worklo	ad					
60 h						
Teachin	ng cycle	9				
Referre	d to in	LPOI (examination regulatio	ns for teaching-degree progra	mmes)		
§ 22 N § 22 N	-					
Module		rs in				
		gree (1 major) Mathema	tics (2015)			
		gree (1 major) Economat				
Bachelor's degree (1 major) Mathematical Physics (2015)						
Bachelor's degree (1 major) Computational Mathematics (2015)						
First state examination for the teaching degree Grundschule Mathematics (2015)						
First state examination for the teaching degree Realschule Mathematics (2015) First state examination for the teaching degree Mittelschule Mathematics (2015)						
Bachelor's degree (1 major) Mathematical Physics (2016)						
Bachelor's degree (1 major) Mathematical Physics (2010) Bachelor's degree (1 major) Economathematics (2017)						
	-	mination for the teaching		Mathematics (2020	(Prüfungsordnungs	version
	-	gree (1 major) Mathema	•			
	-	gree (1 major) Economat				
		gree (1 major) Economat gree (1 major) Mathema		22)		
Bachelor's v	with 1 maj	or Mathematical Physics		generated 19-Apr-2025 • exa		page 123 / 147
2016)				r (180 ECTS) Mathematische		



exchange program Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2025)

Module	e title				Abbreviation	
Reasoning and Writing in Mathematics				10-M-ASM-152-m01		
Module	coord	inator		Module offered by		
		es Mathematik (Mathem	atics)	Institute of Mathem	atics	
ECTS		od of grading				
2		successfully completed				
Duratio		Module level	Other prerequisites			
1 semes		undergraduate				
Conten						
Introdu	ction to ical wri	o fundamental methods ting;insight into examp				
Intende	ed learı	ning outcomes				
	isy mat	acquainted with the ba hematical arguments in				
		umber of weekly contact hours,	language — if other than Ger	rman)		
V (1) + Ü	Ü (1)					
		s essment (type, scope, langu le for bonus)	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		20 pages) ssessment: German and	l/or English			
Allocati			<u> </u>			
Additio	nal inf	ormation				
Worklo	ad					
60 h						
Teachin	ng cycl	e				
			-,-			
Referre	d to in	LPO I (examination regulatio	ns for teaching-degree progra	mmes)		
 Module	e appea	irs in				
		r s in gree (1 major) Mathema	tics (2015)			
Bachelo Bachelo	or's deg or's deg	gree (1 major) Mathema gree (1 major) Economat	hematics (2015)			
Bachelo Bachelo Bachelo	or's deg or's deg or's deg	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema	hematics (2015) tical Physics (2015)			
Bachelo Bachelo Bachelo Bachelo	or's de or's de or's de or's de	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat	hematics (2015) tical Physics (2015) ional Mathematics (20	015)		
Bachelo Bachelo Bachelo Bachelo Bachelo	or's deg or's deg or's deg or's deg or's deg	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema	hematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016)	015)		
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's deg or's deg or's deg or's deg or's deg or's deg	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat	hematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016) thematics (2017)	D15)		
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's deg or's deg or's deg or's deg or's deg or's deg or's deg	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema	hematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016) hematics (2017) tical Physics (2020)	015)		
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's des or's des or's des or's des or's des or's des or's des or's des	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Economat	hematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016) thematics (2017) tical Physics (2020) thematics (2021)	D15)		
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's de or's de or's de or's de or's de or's de or's de or's de or's de	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Economat gree (1 major) Economat	hematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016) thematics (2017) tical Physics (2020) thematics (2021) thematics (2022)			
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's de or's de	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Economat gree (1 major) Economat gree (1 major) Mathema	thematics (2015) tical Physics (2015) ional Mathematics (20 tical Physics (2016) thematics (2017) tical Physics (2020) thematics (2021) thematics (2022) tical Data Science (20			
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo exchan	or's des or's des	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Economat gree (1 major) Economat gree (1 major) Economat gree (1 major) Mathema grem Mathematics (202)	tical Physics (2015) ional Mathematics (2015) ional Mathematics (2016) tical Physics (2017) tical Physics (2020) thematics (2021) thematics (2022) tical Data Science (20 3)			
Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo Bachelo	or's des or's des	gree (1 major) Mathema gree (1 major) Economat gree (1 major) Mathema gree (1 major) Computat gree (1 major) Mathema gree (1 major) Economat gree (1 major) Economat gree (1 major) Economat gree (1 major) Mathema	tical Physics (2015) ional Mathematics (2015) ional Mathematics (2016) tical Physics (2017) tical Physics (2020) thematics (2021) thematics (2022) tical Data Science (20 3) tics (2023)			



Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Economathematics (2025)

Module title Abbreviation					Abbreviation
Semina	r Math	ematical Physics			11-SMP-162-m01
Module	e coord	inator		Module offered by	
chairperson of examination committee Mathematische Physik (Mathematical Physics)				Faculty of Physics a	and Astronomy
ECTS Method of grading Only after succ. compl. of module(s)					
5	(not) s	successfully completed			
Duration Module level Other prerequisites					
1 seme	ı semester undergraduate				
Conten	ts				
A selec	ted top	oic of Mathematical Physi	cs.		
Intende	ed lear	ning outcomes			
	a giver	n topic on the basis of lite			olves the development and divi- ell as the ability to actively partici-
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)	
		t in: German or English			
		GESSMENT (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether
		o minutes) ssessment: German and,	/or English		
Allocat	ion of _l	olaces			
Additio	nal inf	ormation			
Worklo	ad				
150 h					
Teachir	ıg cycl	e			
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	ammes)	
Module					
		gree (1 major) Mathemati	•		
		gree (1 major) Mathemati			
васпею	or's de	gree (1 major) Mathemati	cal Physics (2024)		



Subject-specific Key Skills, Compulsory Electives

(6 ECTS credits)

Module title					Abbreviation
Supple	menta	ry Seminar Mathematics			10-M-SEM2-152-m01
Module	e coord	inator		Module offered by	
Dean of Studies Mathematik (Mathematics)		atics)	Institute of Mathe	ematics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
4	1	successfully completed			
Duration Module level Other prerequisites					
1 seme	ster	undergraduate			
Conten	ts		<u>.</u>		
		bic in mathematics.			
		ning outcomes			
of a giv	en top				nasters elaboration and structuring le/She is able to participate active-
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)	
S (2)					
		Sessment (type, scope, langua Ile for bonus)	ge — if other than German,	examination offered — if	not every semester, information on whether
talk (60	o to 120	o minutes)			
		ssessment: German and,	/or English		
Allocat	ion of _l	olaces			
Additio	onal inf	ormation			
Worklo	ad				
120 h					
Teachi	ng cvcl	e			
	0.95				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module		ars in			
		gree (1 major) Mathemati	(2015)		
		gree (1 major) Mathemati			
		gree (1 major) Computati	, , , ,,	015)	
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2016)		
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2020)		
Bachel	or's de	gree (1 major) Mathemati	cal Data Science (20	22)	
Bachel	or's de	gree (1 major) Mathemati	cs (2023)		
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)		

In-M-TOP-152-m01 Module offered by Module offered by Institute of Mathematik (Mathematik (Mathematics) Institute of Mathematik (Mathematik (Mathematics) Module offered by Institute of Mathematik (Mathematik (Mathematiks) Institute of Mathematik (Mathematik (Mathematiks) Module level Only after succ. compl. of module(s) Duration Module level Other prerequisites Mathematik (Mathematiks) Mathematiks (Mathematiks) Module level Other prerequisites Contents Mathematiks (Mathematiks) Mathematiks (Mathematiks) Mathematiks (Mathematiks) Contents Contents Basics in set-theoretic topology, topological spaces and continuity, separation properties, connectivity, examples and constructions of topological spaces, quotients, convergence of sequences and nets, different notions of comparetness, additional topics (optional), e.g. the theorematics State Arzela-Ascoli and Baire, and introduction or algebra and analysis to topology as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to topology, and realises the broad applicabilit	Module title			Abbreviation	
Dean of Studies Mathematik (Mathematics) Institute of Mathematics ECTS Method of grading Only after succ. compl. of module(s) 5 (not) successfully completed Duration Module level Other prerequisites 1 semester undergraduate Contents Basics in set-theoretic topology, topological spaces and continuity, separation properties, connectivity, examples and constructions of topological spaces, quotients, convergence of sequences and nets, different notions of compactness, additional topics (optional), e. g. the theorems of Stone-Weierstraß, Arzela-Ascoil and Baire, and introduction to algebraic topology. Intended learning outcomes The student knows the fundamental concepts and methods of topology as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to topology, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (2) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment (Grees in which the course is offered and in the subsequent semester creditable for bonus Allocation of places	Introduction	to Topology			10-M-TOP-152-m01
ECTS Method of grading Only after succ. compl. of module(s) 5 (not) successfully completed Duration Module level Other prerequisites 1 semester undergraduate Contents Basics in set-theoretic topology, topological spaces and continuity, separation properties, connectivity, examples and constructions of topological spaces, quotients, convergence of sequences and nets, different notions of compactness, additional topics (optional), e. g. the theorems of Stone-Weierstraß, Arzela-Ascoli and Baire, and introduction to algebraic topology. Intended learning outcomes Intended learning outcomes The student knows the fundamental concepts and methods of topology, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (2) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination of one candidate each (15 to 30 minutes) or c) arale examination of groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered	Module coordinator			Module offered by	
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5 (not) successfully completed Duration Module level Other prerequisites 1 semester undergraduate Contents Basics in set-theoretic topology, topological spaces and continuity, separation properties, connectivity, examples and constructions of topological spaces, quotients, convergence of sequences and nets, different notions of compactness, additional topics (optional), e. g. the theorems of Stone-Weierstraß, Arzela-Ascoli and Baire, and introduction to algebraic topology. Intended learning outcomes The student knows the fundamental concepts and methods of topology as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to topology, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (2) + Ü (2) Method of assessment (type, scope, language – if other than German) V (2) + Ü (2) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) or al examination of one candidate each (15 to 30 minutes) or c) or al examination of groups of 2, to to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus Allocation of places	ECTS Method of grading Only after succ. o		Only after succ. com	pl. of module(s)	
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is able to apply methods from linear algebra and analysis to topology, and realises the broad applicability of the theory to other branches of mathematics. Courses (type, number of weekly contact hours, language – if other than German) V (2) + Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus Allocation of places	Intended lear	ning outcomes			
V (2) + Ü (2) 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 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus Allocation of places 	is able to app theory to othe	ly methods from linear al er branches of mathemati	gebra and analysis to cs.	topology, and realis	
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 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus Allocation of places		number of weekly contact hours, l	anguage — if other than Ger	man)	
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	b) oral exami c) oral exami Language of a Assessment o	b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English Assessment offered: In the semester in which the course is offered and in the subsequent semester			
	Allocation of	places			
Additional information	Additional in	formation			
Workload	Workload				
150 h					
Teaching cycle		A			
Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module appears in					
Bachelor's degree (1 major) Mathematics (2015)			cs (2015)		
Bachelor's degree (1 major) Mathematical Physics (2015)					
Bachelor's degree (1 major) Computational Mathematics (2015)				915)	
Bachelor's degree (1 major) Mathematical Physics (2016)			•		
	Bachelor's degree (1 major) Mathematical Physics (2020)				
		Bachelor's degree (1 major) Mathematics (2023)			
Bachelor's degree (1 major) Mathematical Physics (2024)	Bachelor's de	egree (1 major) Mathemati	cs (2023)		

Bachelor's with 1 major Mathematical Physics	Γ
(2016)	

Module title Abbreviation						
Compu	tationa	al Mathematics			10-M-COM-152-m01	L
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. con			
4		successfully completed				
Duratio		Module level	Other prerequisites			
		-				
1 seme		undergraduate	I			
-		1 11 11 11			A (1) (1) AA (1)	
		o modern mathematical utation (e. g. Matlab) to :				
		-G). Computer-based so				
		egral calculus; visualisa				
Intende	ed lear	ning outcomes				
The stu	ıdent le	earns the use of advance	d modern mathemati	cal software package	es, and is able to ass	sess their
fields o	of appli	cation to solve mathema	tical problems.			
Course	S (type, r	number of weekly contact hours,	language — if other than Ge	rman)		
V (1) +	Ü (2)					
Method	d of ass	Sessment (type, scope, langu	age — if other than German,	examination offered — if no	ot every semester, informati	ion on whether
module is	s creditab	le for bonus)				
project	in the	form of programming ex	ercises (approx. 20 to	25 hours)		
-	-	ssessment: German and				
Assess	ment o	ffered: Once a year, win	ter semester			
Allocat	ion of _l	places				
			-			
Additio	onal inf	ormation				
	_					
Worklo	ad					
120 h						
Teachi	ng cvcl	e				
	0.7					
Referre	d to in	LPO I (examination regulation	s for toaching dogroo progra	ummoc)		
§ 22						
-		are in				
Module			ing (agas)			
		gree (1 major) Mathemat gree (1 major) Physics (2				
		gree (1 major) Physics (2 gree (1 major) Nanostruc	-	c)		
		gree (1 major) Economat				
		gree (1 major) Mathemat				
		gree (1 major) Computat	• -	015)		
		gree (1 major) Functiona		5.		
		mination for the teachin	_	Mathematics (2015)		
		gree (1 major) Mathemat				
		gree (1 major) Economat	•			
		mination for the teachin		Mathematics (2019)		
Bachel	or's de	gree (1 major) Physics (2	020)			
Bachelor's	with 1 ma	jor Mathematical Physics	IMU Würzburg •	generated 19-Apr-2025 • exa	am. reg. da-	page 131 / 147
(2016)		,		r (180 ECTS) Mathematische	-	,

Bachelor's degree (1 major) Nanostructure Technology (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Fucnomathematics (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Economathematics (2025)

Module title Abbreviation						
Program	mming	course for students of I	Mathematics and othe	r subjects	10-M-PRG-152-m01	
Module	coord	inator		Module offered by		
		es Mathematik (Mathem	atics)	Institute of Mather	natics	
ECTS		od of grading	Only after succ. con		inatics	
3 Duratio		Successfully completed Module level	 Other preveruisites			
			Other prerequisites			
1 seme		undergraduate				
Conten						
		odern programming lang	guage (e.g.C).			
Intende	ed learn	ning outcomes				
The stu in math		able to work independers.	ently on small program	nming exercises and	l standard programm	ing problems
Course	S (type, n	umber of weekly contact hours,	language — if other than Ger	man)		
P (2)						
Method		s essment (type, scope, langu le for bonus)	age — if other than German, o	examination offered — if n	ot every semester, informati	on on whether
		form of programming ex ssessment: German and		25 hours)		
Assess	ment o	ffered: Once a year, sun	nmer semester			
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
90 h			_			
Teachir	ıg cycl	e				
Referre	d to in	LPO I (examination regulatio	ns for teaching-degree progra	mmes)		
§ 22				-		
Module		ins in				
		gree (1 major) Mathema	tics (2015)			
		gree (1 major) Physics (2				
		gree (1 major) Nanostru	-	5)		
Bachel	or's deg	gree (1 major) Economat	hematics (2015)			
Bachel	or's deg	gree (1 major) Mathema	tical Physics (2015)			
		gree (1 major) Computat		015)		
		gree (1 major) Functiona				
		mination for the teachin		Mathematics (2015)		
		gree (1 major) Mathema	•			
		gree (1 major) Economat mination for the teachir		Mathematics (2012))	
		gree (1 major) Physics (2		mainematics (2019)	
		gree (1 major) Nanostru		0)		
		gree (1 major) Mathema				
		gree (1 major) Functiona	•			
Bachelor's (2016)	with 1 maj	or Mathematical Physics	-	generated 19-Apr-2025 • ex r (180 ECTS) Mathematische	-	page 133 / 147

Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Economathematics (2021) Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Economathematics (2025)

Module	e title				Abbreviation		
Selecte	ed Topi	cs in History of Mathem	atics		10-M-GES-152-m01		
Module	e coord	inator		Module offered by			
Dean of	f Studie	es Mathematik (Mathen	natics)	Institute of Mathem	atics		
ECTS		od of grading					
	· · · · · ·			after succ. compl. of module(s)			
5		successfully completed					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	undergraduate					
Conten	ts						
the fun	damen	cultural development a tals of mathematics, in ematics in modern soc	particular in its relatio				
Intende	ed learr	ning outcomes					
tical the audien	eories a ce.	cted examples, the stud and their social relevan	ce. He/she is able to p	resent mathematica			
		umber of weekly contact hours	, language — It other than Ger	man)			
V (2) +							
		s essment (type, scope, langu le for bonus)	uage — if other than German, e	examination offered — if no	t every semester, informat	ion on whether	
Langua	ge of a ment o	< (15 to 25 hours) ssessment: German an ffered: In the semester blaces		offered and in the su	ıbsequent semester		
Additio	nal info	ormation					
Worklo	ad						
150 h							
Teachir		a					
	ig cycu	e					
		LPO I (examination regulation	ns for teaching-degree progra	mmes)			
§ 22							
Module							
		gree (1 major) Mathema					
		gree (1 major) Mathema	,				
Bachelor's degree (1 major) Computational Mathematics (2015) First state examination for the teaching degree Gymnasium Mathematics (2015)							
First st-		gree (1 major) Mathema	,	mathematics (2015)			
			(2010)				
Bachelo			ng degree Gymnasium	Mathematics (2010)			
Bachelo First sta	ate exa	mination for the teaching	,	Mathematics (2019)			
Bachelo First sta Bachelo	ate exa or's deg		tical Physics (2020)	-			
Bachelo First sta Bachelo Bachelo	ate exa or's deg or's deg	mination for the teachingree (1 major) Mathema	tical Physics (2020) tical Data Science (202	-			
Bachelo First sta Bachelo Bachelo exchan	ate exa or's deg or's deg ge prog	mination for the teachir gree (1 major) Mathema gree (1 major) Mathema	tical Physics (2020) tical Data Science (202 3)	22)			
Bachelo First sta Bachelo Bachelo exchan First sta	ate exa or's deg or's deg ge prog ate exa	mination for the teachir gree (1 major) Mathema gree (1 major) Mathema gram Mathematics (202	tical Physics (2020) tical Data Science (202 3) ng degree Gymnasium	22)		page 135 / 147	



Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module	e title			Abbreviation		
Mathe	Mathematical Writing 10-M-MSC-152-m01					
Module	e coord	inator		Module offered by	<u> </u>	
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	(not)	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts		•			
vers the compre	Discussion of good and bad mathematical writing using practical exercises and case examples. The course co- vers the whole range of mathematical texts from short proofs and the formulation of theorems and definitions to comprehensive works such as Bachelor's or Master's theses. Important aspects include not only mathematical rigour and efficiency but also didactic questions.					
Intende	ed lear	ning outcomes				
		able to formulate math actures and conventions				
		number of weekly contact hours,				
V (2) +	-					
		sessment (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		ole for bonus) 90 minutes) or				
b) term c) proje Langua	paper ect wor ge of a	(10 to 15 pages) or k (15 to 25 hours) ssessment: German and ffered: In the semester i		offered and in the su	ıbsequent semester	
Allocat	ion of	places				
	1					
Additio	nal inf	ormation				
Worklo	ad					
150 h			_			
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)		
§ 22	Nr. 3 f)					
Module	e appea	ars in				
Bachel	or's de	gree (1 major) Mathema	tics (2015)			
		gree (1 major) Mathemat	,			
		gree (1 major) Computat		-		
		mination for the teachin gree (1 major) Mathemat		Mathematics (2015)		
		mination for the teachin	•	Mathematics (2019)		
		gree (1 major) Mathemat				
		gree (1 major) Mathema		22)		
		gram Mathematics (202				
First sta	ate exa	mination for the teachin	g degree Gymnasium	Mathematics (2023)		
Bachelor's (2016)	with 1 ma	jor Mathematical Physics	-	generated 19-Apr-2025 • exa r (180 ECTS) Mathematische	_	page 137 / 147



Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

School	Module title Abbreviation										
School Mathematics from a Higher Perspective 10-M-SCH-152-mo1					10-M-SCH-152-m01						
Module	e coord	inator		Module offered by							
Dean o	f Studi	es Mathematik (Mathem	natics)	Institute of Mathem	atics						
ECTS		od of grading	Only after succ. con	npl. of module(s)							
		successfully completed									
5 Duratio		Module level	Other prerequisites								
1 semes		undergraduate									
Conten											
		selected topics in schoo implementation at both			ation into wider the	ories and					
Intende	ed lear	ning outcomes									
	vancec	elected examples, the s I mathematical theories ct.									
Course	S (type, r	number of weekly contact hours	language — if other than Ger	rman)							
V (2) + I	Ü (2)										
Method	d of ass	sessment (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informat	ion on whether					
module is	creditab	le for bonus)									
Langua Assessi	ge of a ment o	k (15 to 25 hours) Issessment: German and Iffered: In the semester		offered and in the su	ibsequent semester	•					
Allocat	ion of _l	places									
			_								
Additio	nal inf	ormation									
			_								
Worklo	ad					Workload					
150 h											
Teaching cycle											
Teachir											
Teachir		e									
	d to in	e LPO I (examination regulatio	ns for teaching-degree progra	ammes)							
	Nr. 1 h) Nr. 2 f)	LPO I (examination regulatio	ns for teaching-degree progra	ammes)							
 Referre § 22 § 22 § 22	Nr. 1 h) Nr. 2 f) Nr. 3 f)	LPOI (examination regulatio	ns for teaching-degree progra	ammes)							
 Referre § 22 § 22 § 22 Module	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appe a	LPOI (examination regulatio		ammes)							
 Referre § 22 § 22 § 22 Module Bachelo Bachelo	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema	tics (2015) tical Physics (2015)								
 Referre § 22 § 22 § 22 Module Bachelo Bachelo Bachelo	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computat	tics (2015) tical Physics (2015) ional Mathematics (20	015)							
 Referre § 22 § 22 § 22 Module Bachelo Bachelo First sta	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de or's de ate exa	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computat mination for the teachir	tics (2015) tical Physics (2015) ional Mathematics (20 g degree Grundschule	015) e Mathematics (2015))						
 Referre § 22 § 22 Module Bacheld Bacheld Bacheld First sta First sta	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de or's de ate exa ate exa	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computate mination for the teachir mination for the teachir	tics (2015) tical Physics (2015) ional Mathematics (20 g degree Grundschule g degree Realschule N	015) e Mathematics (2015) Mathematics (2015))						
 Referre § 22 N § 22 N § 22 N Module Bachelo Bachelo Bachelo First sta First sta First sta	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de or's de ate exa ate exa ate exa	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computat mination for the teachir mination for the teachir mination for the teachir	tics (2015) tical Physics (2015) ional Mathematics (20 g degree Grundschule g degree Realschule M g degree Gymnasium	015) e Mathematics (2015) Mathematics (2015) Mathematics (2015)							
First sta First sta First sta	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de ate exa ate exa ate exa ate exa ate exa	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computat mination for the teachir mination for the teachir mination for the teachir mination for the teachir mination for the teachir	tics (2015) tical Physics (2015) ional Mathematics (20 g degree Grundschule g degree Realschule M g degree Gymnasium g degree Mittelschule	015) e Mathematics (2015) Mathematics (2015) Mathematics (2015)							
First sta Bachelo Bachelo First sta First sta Bachelo	Nr. 1 h) Nr. 2 f) Nr. 3 f) e appea or's de or's de or's de ate exa ate exa ate exa ate exa ate exa ate exa	LPO I (examination regulation ars in gree (1 major) Mathema gree (1 major) Mathema gree (1 major) Computat mination for the teachir mination for the teachir mination for the teachir	tics (2015) tical Physics (2015) ional Mathematics (20 g degree Grundschule g degree Realschule M g degree Gymnasium g degree Mittelschule tical Physics (2016)	015) e Mathematics (2015) Mathematics (2015) Mathematics (2015) e Mathematics (2015)							



First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))

Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023)

Bachelor's degree (1 major) Mathematical Physics (2024)

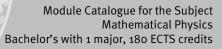
Module	Module title Abbreviation					
Prosem	ninar M	athematics			10-M-PRO-152-m01	
Module	e coord	inator		Module offered by	<u> </u>	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	v after succ. compl. of module(s)		
4	4 (not) successfully completed					
Duratio	Duration Module level Other prerequisites					
1 seme	1 semester undergraduate					
Contents						
Selecte	d basi	c topics in mathematics.				
Intende	ed lear	ning outcomes				
of a giv	en top				sters elaboration and structuring /She is able to participate active-	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)		
S (2)						
module is	creditab	le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether	
Langua	ge of a	o minutes) ssessment: German and, ffered: In the semester in		offered		
Allocat	ion of _l	olaces				
Additio	nal inf	ormation				
Worklo	ad					
120 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	immes)		
Module	e appea	ars in				
		gree (1 major) Mathemati	-			
		gree (1 major) Mathemati				
		gree (1 major) Computatio		015)		
		gree (1 major) Mathemati	•			
		gree (1 major) Mathemati	•			
		gram Mathematics (2023) gree (1 major) Mathemati				
		gree (1 major) Mathemati gree (1 major) Mathemati	_			
Duchet		Siec (1 major) Mathemati	cuti ilysics (2024)			

Module title Abbreviation					Abbreviation
Mathe	matica	Methods of Physics			11-M-MR-152-m01
Module	e coord	inator		Module offered by	
		ector of the Institute of Tl	neoretical Physics	Faculty of Physics a	nd Astronomy
and As	-		reoreticat i fiysics		ind Astronomy
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)	
6	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites	5	
2 seme	ester	undergraduate			
Conten			<u> </u>		
Princip ductior	les of r n to an	d preparation of the mod			rriculum, especially for the intro- or Experimental Physics.
Intend	ed lear	ning outcomes			
		have knowledge of the p eoretical and Experimen		tics and elementary	calculation methods which are
Course	S (type, I	number of weekly contact hours,	language — if other than Ge	rman)	
		V (2) + Ü (1) t in: German or English			
			age — if other than German	examination offered — if no	t every semester, information on whether
		ble for bonus)			,, moniation on writting
a) exer	cises (successful completion of	approx. 50% of appr	ox. 13 exercise sheet	s) or
		x. 15 minutes)			
Allocat	ion of	places			
Additic	onal inf	ormation			
Worklo	ad				
180 h					
Teachi	ng cực	P			
reacini	ing cycl	•			
		LPO I (examination regulation	is for teaching-degree progra	ammes)	
§ 53 N <u>§ 77 N</u>					
Module	e appea	ars in			
	or's de	gree (1 major) Physics (2			
			/	-)	
Bachel		gree (1 major) Nanostruc		5)	
Bachel Bachel	or's de	gree (1 major) Mathemat	ical Physics (2015)	5)	
Bachel Bachel Bachel	or's de or's de	gree (1 major) Mathemat gree (1 major, 1 minor) P	ical Physics (2015) hysics (Minor, 2015)	-	
Bachel Bachel Bachel First sta	or's de or's de ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschul	e Physics (2015)	
Bachel Bachel Bachel First sta First sta	or's de or's de ate exa ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschul g degree Realschule	e Physics (2015) Physics (2015)	
Bachel Bachel Bachel First sta First sta First sta	or's de or's de ate exa ate exa ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschule g degree Realschule g degree Gymnasium	e Physics (2015) Physics (2015) Physics (2015)	
Bachel Bachel Bachel First sta First sta First sta	or's de or's de ate exa ate exa ate exa ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschule g degree Realschule g degree Gymnasium g degree Mittelschule	e Physics (2015) Physics (2015) Physics (2015)	
Bachel Bachel First sta First sta First sta First sta Bachel	or's de or's de ate exa ate exa ate exa ate exa or's de	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin mination for the teachin mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschule g degree Realschule g degree Gymnasium g degree Mittelschule ical Physics (2016)	e Physics (2015) Physics (2015) Physics (2015) e Physics (2015)	
Bachel Bachel First sta First sta First sta First sta Bachel First sta First sta	or's de or's de ate exa ate exa ate exa ate exa or's de ate exa ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin mination for the teachin mination for the teachin gree (1 major) Mathemat mination for the teachin mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschule g degree Realschule g degree Gymnasium g degree Mittelschule ical Physics (2016) g degree Grundschule g degree Realschule	e Physics (2015) Physics (2015) Physics (2015) e Physics (2015) e Physics (2018) Physics (2018)	
Bachel Bachel First sta First sta First sta First sta Bachel First sta First sta	or's de or's de ate exa ate exa ate exa ate exa or's de ate exa ate exa	gree (1 major) Mathemat gree (1 major, 1 minor) P mination for the teachin mination for the teachin mination for the teachin mination for the teachin gree (1 major) Mathemat mination for the teachin	ical Physics (2015) hysics (Minor, 2015) g degree Grundschule g degree Realschule g degree Gymnasium g degree Mittelschule ical Physics (2016) g degree Grundschule g degree Realschule	e Physics (2015) Physics (2015) Physics (2015) e Physics (2015) e Physics (2018) Physics (2018)	



First state examination for the teaching degree Mittelschule Physics (2018)

Module title Abbreviat					Abbreviation	bbreviation	
Comput	tationa	l Physics		-	11-CP-152-m01		
Module	coord	inator		Module offered by			
Managi and Ast		ector of the Institute of T sics	heoretical Physics	Faculty of Physics a	nd Astronomy		
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)			
6	nume	rical grade					
Duratio	n	Module level	Other prerequisites	6			
1 semes	ster	undergraduate					
Conten	ts						
 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 							
Intende	ed leari	ning outcomes					
They ha	ive kno	nave knowledge of two wledge of numerical st ysical problems, e.g. al	andard methods and a	are able to apply com	puter-assisted proc		
Courses	S (type, n	umber of weekly contact hours	, language — if other than Ge	rman)			
V (3) + I Module		t in: German or English					
Method	l of ass	s essment (type, scope, langu	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether	
		le for bonus)					
b) oral e c) oral e d) proje If a writ stead ta of asses nation e Langua	 a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: German and/or English Assessment offered: Once a year, winter semester 						
Allocati	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
180 h							
Teachir	ng cycl	e					
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	ammes)			
Module	appea	in					
Bachelo	or's de	gree (1 major) Physics (2	2015)				
Bachelor's v (2016)	with 1 maj	or Mathematical Physics		• generated 19-Apr-2025 • exa or (180 ECTS) Mathematische	-	page 144 / 147	



Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Physics (2020) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)



Thesis (10 ECTS credits)

Module	Module title Abbreviation					
Bachel	or Thes	sis Mathematical Physics	5		10-M-BAP-152-m01	
Module	e coord	inator		Module offered by	1	
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	natics	
ECTS	TS Method of grading Only after succ. compl. of module(s)					
10	nume	rical grade	de			
Duratio	on	Module level	Other prerequisites			
1 seme	ester	undergraduate	Where applicable, topic-specific modules as specified by supervisor.			
Conten	nts					
		y researching and writing ation with the supervisor		erdisciplinary) topic	in mathematics or physics selec-	
Intend	ed lear	ning outcomes				
and ap	ply the				topic in mathematics or physics e can write down the result of	
Course	S (type, r	number of weekly contact hours, l	anguage — if other than Ger	rman)		
No cou	irses as	signed to module				
		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. 250 to 300 hou	rs total)			
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Time to	o comp	ete: 10 weeks.				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
	_					
Referre	ed to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		
Module	e appea	ars in				
		gree (1 major) Mathemati	, , ,			
		gree (1 major) Mathemati	-			
		gree (1 major) Mathemati	•			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)			