

# Module Catalogue

for the Subject

## **Computational Mathematics**

as a Master's with 1 major with the degree "Master of Science" (120 ECTS credits)

Examination regulations version: 2019 Responsible: Faculty of Mathematics and Computer Science Responsible: Institute of Mathematics

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record 88|f24|-|-|H|2019



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## The subject is divided into

section / sub-section	ECTS credits	starting page
Compulsory Electives	90	10
Subfield Numerical Mathematics and Optimization	30	11
Subfield Mathematics	10	32
Subfield Research in Groups and Seminars	10	113
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Application Subject Biology and Medicine		133
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## **Learning Outcomes**

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German contents and learning outcome available but not translated yet.

#### Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein stark ausgeprägtes 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 aktuelle Forschungsgebiete der Mathematik, insbesondere der Numerischen Mathematik einzuarbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen zu komplexen Sachverhalten einem Fachpublikum gegenüber verständlich zu präsentieren.
- Die Absolventinnen und Absolventen besitzen die für selbstständiges wissenschaftliches Arbeiten, insbesondere für ein Promotionsstudium erforderlichen Fachkenntnisse, Denk- und Arbeitsweisen und Methodenkenntnisse.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie bei umfangreichen Arbeiten zu beachten.
- Die Absolventinnen und Absolventen besitzen weiterführende Kenntnisse aktueller Gebiete der Angewandten Mathematik und können sicher mit fortgeschrittenen Methoden dieser Gebiete umgehen.
- Die Absolventinnen und Absolventen besitzen vertiefte Kenntnisse und Überblick über die aktuelle Forschung in mindestens einem Teilgebiet der Mathematik.
- Die Absolventinnen und Absolventen kennen aktuelle Gebiete und moderne Methoden eines weiteren Fachs aus dem Bereich der Naturwissenschaften und der Informatik.

#### Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein stark ausgeprägtes 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 zu formulieren und zu präsentieren.
- Die Absolventinnen und Absolventen sind in der Lage, komplexe Probleme aus anderen Gebieten zu erkennen, strukturieren und modellieren, mit mathematischen Methoden Lösungswege zu entwickeln und diese Ergebnisse zu interpretieren und bewerten.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in Teams zu arbeiten und hierbei Verantwortung zu tragen.
- Die Absolventinnen und Absolventen sind in der Lage, sich neue Wissensgebiete und aktuelle Entwicklungen selbständig, effizient und systematisch zu erschließen.
- Die Absolventinnen und Absolventen besitzen die Fähigkeit, Projekte in interdisziplinär zusammengesetzten Teams im Bereich der Informatik, Natur- und Ingenieurswissenschaften verantwortlich mitzugestalten.

#### Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein stark ausgeprägtes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, in partizipativen Prozessen gestaltend mitzuwirken.

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- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, komplexe Ideen und Lösungsvorschläge allgemeinverständlich zu formulieren und professionell zu präsentieren.

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## Abbreviations used

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

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

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

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

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

## Conventions

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

## Notes

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

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

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

### In accordance with

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

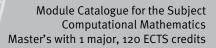
#### ASPO2015

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

#### 27-Mar-2019 (2019-23)

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





## **Compulsory Electives**

(90 ECTS credits)



## Subfield Numerical Mathematics and Optimization

(30 ECTS credits)

Module title			Abbreviation			
Applied	Applied Analysis				10-M=AAAN-161-mo	01
Module	e coord	inator		Module offered by		
Dean of	f Studi	es Mathematik (Mathen	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites	i i		
1 seme	ster	graduate				
Conten	ts					
theory of particul theory of Recomm	of Hilbo lar FEN of ellip mende	y of functional analysis ert spaces and Fourier a I methods), principles o tic, parabolic and hyper d previous knowledge: h the contents of the m	nalysis, spectral theor f functional analysis, f bolic partial differenti	y and quantum mech function spaces, emb al equations with me	hanics, numerical m bedding theorems, c thods from function	ethods (in ompactness,
		ning outcomes			Jiiiiieiided.	
The stu to estal	dent is blish a	acquainted with the fu connection between hi ther natural and engine	s/her acquired skills a			
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or Eng	glish			
		<b>Sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral e Langua	examir examin ge of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester honus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachir	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	immes)		
Module	e appea	urs in				
Module appears inMaster's degree (1 major) Mathematics (2016)Master's degree (1 major) Physics (2016)Master's degree (1 major) Economathematics (2016)Master's degree (1 major) Mathematical Physics (2016)Master's degree (1 major) Computational Mathematics (2016)						
Master's wi (2019)	th 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 12 / 349

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Module title			Abbreviation			
Selecte	ed Topi	cs in Optimization			10-M=VOPT-161-mc	)1
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathe	matics)	Institute of Mathem	natics	
ECTS	1	od of grading	Only after succ. con			
10		rical grade		······································		
Duratio		Module level	Other prerequisites			
1 seme		graduate				
		glauuale				
	<b>Contents</b> Selected topics in optimization, e. g. inner point methods, semidefinite programs, non-smooth optimization, ga-					
		timization with differer		semiderinite program	is, non-smooth optin	nization, ga-
Intend	ed lear	ning outcomes				
		acquainted with adva research questions in			He gains the ability t	o work on
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (4) +	Ü (2)					
Module	e taugh	t in: German and/or En	glish			
Metho	d of ass	<b>Sessment</b> (type, scope, lang	guage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether
module i	s creditab	le for bonus)				
c) oral Langua Assess	examin age of a	nation of one candidate ation in groups (group ssessment: German or ffered: In the semester bonus	s of 2, 15 minutes per c English	andidate)	ubsequent semester	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
	ng cycl	e				
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Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)		
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Module	e appea	ars in				
		ee (1 major) Mathemati	ics (2016)			
	-	ee (1 major) Economath				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
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	-	ee (1 major) Mathemati	-	ion DILIC Elito Noter	ork Bayaria (END) (a	020)
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Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 14 / 349

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

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module	e title				Abbreviation	
Selecte	Selected Topics in Mathematical Physics				10-M=VMPH-161-m	101
Module	e coord	inator		Module offered by		
		es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	r – –	od of grading	Only after succ. con			
10	1	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	graduate	 			
Conten	ts	5	I			
terial s Recom Depene	ciences mende ding on	s in mathematical phys geometric field theory d previous knowledge: the content, basic and commended to consult t	, advanced topics in q advanced knowledge	uantum theory.		
		ning outcomes				
		acquainted with an adv	anced topic in mathe	matical physics. How	She is able to estab	lish a
		tween his/her acquired				
Course	<b>S</b> (type, n	umber of weekly contact hours,	language — if other than Ger	rman)		
V (4) + Module	• •	t in: German and/or Eng	lish			
Metho	d of ass	<b>essment</b> (type, scope, langu	age — if other than German,	examination offered — if no	ot every semester, informat	tion on whether
		le for bonus)				
b) oral c) oral Langua	examin examin Ige of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or E ffered: In the semester i bonus	each (approx. 20 minu of 2, 15 minutes per c English	ıtes) or andidate)	ubsequent semester	r
Allocat	ion of p	olaces				
Additio	onal info	ormation				
			_			
Worklo	ad		_			
300 h						
-	ng cycl	9				
	0.7	-				
Referre	d to in	LPO I (examination regulatio	ns for teaching-degree progra	mmes)		
				/		
Module	e appea	irs in				
		ee (1 major) Mathematic	s (2016)			
Master	's degr	ee (1 major) Physics (20 ee (1 major) Mathematic	16)			
Master's degree (1 major) Mathematical Mysics (2010) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)						
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Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

Module title			Abbreviation			
Basics	in Opt	imization			10-M=AOPT-161-mc	)1
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathem	natics	
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	;		
1 seme	ster	graduate				
Conten	Its					
		methods and technique ted optimization, exam				
Intende	ed lear	ning outcomes				
		nows the fundamental ecide which method is			lge their strengths a	nd weaknes-
Course	<b>S</b> (type, I	number of weekly contact hours	s, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or En	glish			
		<b>Sessment</b> (type, scope, lang ble for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
	ment o ble for			offered and in the su	ubsequent semester	
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Additio		ormation				
Worklo	he					
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Master's degree (1 major) Mathematical Physics (2016)						
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	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)					
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exchange program Mathematics (2023)

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

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module title		Abbreviation				
Mather	matical	Continuum Mechanics	;		10-M=VKOM-161-m	01
Module coordinator			Module offered by			
Dean o	f Studi	es Mathematik (Mathe	matics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. con			
5		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		Sidduite				
		ntial equations and/or	variational methods in	the context of contir	nuum mechanics.	
Basic k	nowled	d previous knowledge: lge from the modules " recommended, as well			duction to Partial Dif	ferential
Intende	ed lear	ning outcomes				
		asters the mathematic application.	al methods in mathem	atical continuum me	chanics and knows	about their
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (3) +	Ü (1)					
Module	e taugh	t in: German and/or En	glish			
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
b) oral c) oral Langua	examir examin Ige of a	mination (approx. 60 to nation of one candidate nation in groups (group ssessment: German or ffered: In the semester	each (approx. 15 minu s of 2, approx. 10 minu English	ites) or tes per candidate)	ıbsequent semester	
credita						
Allocat	ion of <sub>l</sub>	olaces				
Additio	onal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cvcl	e				
Referre	ed to in	LPOI (examination regulati	ons for teaching-degree progra	ammes)		
Module	e appea	ars in				
		ee (1 major) Mathemati	cs (2016)			
Master's degree (1 major) Mathematical Physics (2016)						
	-	ee (1 major) Computati				
		hing degree Gymnasiur				016)
		ry course MINT Teacher			B) (2016)	
	-	ee (1 major) Computati		9)		
		ee (1 major) Mathemati				,
		ning degree Gymnasiur				
Master's wi (2019)	iin 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen		page 20 / 349

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Module title					Abbreviation	
Numeric of Large Systems of Equations       10-M=ANGG-161-m01					01	
Module	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathematic			natics)	Institute of Mathematics		
ECTS Method of grading Only after succ. compl. of module(s)						
10	nume	rical grade				
Duration Module level Other prerequisites						
1 seme	ster	graduate				
Conten	ts					
Discret	isation	of elliptic differential e	quations, classical iter	ration methods, prec	onditioners, multigr	id methods.
Basic k and "N	nowlea umeric	d previous knowledge: lge of numerical mathe al Mathematics 2", is re nended.				
Intende	ed lear	ning outcomes				
		acquainted with the m ient way to solve a give			stems of equations,	and knows
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or Eng	glish			
		sessment (type, scope, langu		examination offered — if no	t every semester, informati	ion on whether
module is	s creditab	le for bonus)				
b) oral c) oral Langua	examir examin Ige of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of <b>j</b>	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	ρ				
		•				
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)		
Module appears in						
	-	ee (1 major) Mathemati				
	-	ee (1 major) Economath				
	-	ee (1 major) Mathematic	-			
	-	ee (1 major) Computatio			and Deverte (END) (	
		hing degree Gymnasium				016)
		ry course MINT Teacher ee (1 major) Computatic			в) (2016)	
	-	r Computational Mathematics		9) enerated 19-Apr-2025 • exam	. reg. data re-	page 22 / 349
(2019)				ECTS) Computational Mathen	-	F=35 == 7 547



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

	e title				Abbreviation	
Numeric of Partial Differential Equations					10-M=VNPE-161-m	01
Module coordinator				Module offered by		
Dean of Studies Mathematik (Mathematics)			Institute of Mathem	natics		
ECTS	1	od of grading	Only after succ. con			
	1					
10   numerical grade      Duration   Module level   Other prerequired			Other prerequisites			
			1			
1 semester graduate						
Conten			<u> </u>	a . 116		
(numer discont Recom We reco	rical me tinuous mende ommer	al differential equations, ethods for elliptic, parab s Gelerkin finite element d previous knowledge: id basic knowledge of fu	olic and hyperbolic pa s method, finite differ nctional analysis and	artial differential equ ences and finite volu   partial differential e	ations; finite eleme ume methods). equations, such as ca	nts method,
		ules "Introduction to Fu	nctional Analysis" an	d "Applied Analysis"	•	
		ning outcomes			and a language of the	
		acquainted with advan			ential equations.	
		number of weekly contact hours,	language — if other than Ge	rman)		
V (4) + Module		t in: German and/or Eng	lish			
		sessment (type, scope, langu	age — if other than German,	examination offered — if no	ot every semester, informat	ion on whether
	en exa	mination (approx. 90 to nation of one candidate (				
a) writt b) oral c) oral Langua Assess	en exan examir examin ige of a ment o	mination (approx. 90 to nation of one candidate o ation in groups (groups ssessment: German or E ffered: In the semester i	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess credita	en exan examir examin ige of a ment o ble for	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or E ffered: In the semester i bonus	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess	en exan examir examin ige of a ment o ble for	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or E ffered: In the semester i bonus	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess credita <b>Allocat</b>	en examir examir examin nge of a ment o ble for <b>ion of j</b>	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess credita <b>Allocat</b>	en examir examir examin nge of a ment o ble for <b>ion of j</b>	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or E ffered: In the semester i bonus	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess credita Allocat  Additio	en examir examir examin ige of a ment o ble for ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral d Langua Assess credita Allocat  Additio  Worklo	en examir examir examin ige of a ment o ble for ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral Langua Assess credita Allocat  Additio  Soo h	en examir examir examin ige of a ment o ble for ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		· · · · · · · · · · · · · · · · · · ·
a) writt b) oral c) oral d Langua Assess credita Allocat  Additio  Worklo	en examir examir examin ige of a ment o ble for ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 mini of 2, 15 minutes per c Inglish	utes) or andidate)		
a) writt b) oral c) oral d Langua Assess credita Allocat  Additio  Worklo 300 h Teachin 	en examir examir examin ige of a ment o ble for ion of p ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b> ormation	each (approx. 20 min of 2, 15 minutes per c English n which the course is	utes) or andidate) offered and in the su		
a) writt b) oral c) oral d Langua Assess credita Allocat  Additio  Worklo 300 h Teachin 	en examir examir examin ige of a ment o ble for ion of p ion of p onal inf	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b>	each (approx. 20 min of 2, 15 minutes per c English n which the course is	utes) or andidate) offered and in the su		
a) writt b) oral c) oral d Langua Assess credita Allocat  Additio  300 h Teachin  Referre 	en examir examin ige of a ment o ble for ion of j onal inf pad	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>blaces</b> ormation e LPO I (examination regulation	each (approx. 20 min of 2, 15 minutes per c English n which the course is	utes) or andidate) offered and in the su		
a) writt b) oral c) oral d Langua Assess credita Allocat  Worklo 300 h Teachin  Referre  Module	en examir examin ge of a ment o ble for ion of p mal inf ad ng cycl	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus blaces ormation e LPO I (examination regulation ars in	each (approx. 20 minu of 2, 15 minutes per c inglish n which the course is	utes) or andidate) offered and in the su		
a) writt b) oral c) oral Langua Assess credita Allocat  Modultio 300 h Teachin  Referre  Module	en exa examir examin ge of a ment o ble for ion of p onal inf onal inf ead ed to in e appea	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus blaces ormation e (e LPO I (examination regulation ars in ee (1 major) Mathematic	each (approx. 20 minu of 2, 15 minutes per c English n which the course is	utes) or andidate) offered and in the su		
a) writt b) oral c) oral Langua Assess credita Allocat  Additio  300 h Teachin  Referre  Module Master Master	en examir examir examin ige of a ment o ble for ion of j onal inf onal inf onal inf ead ed to in 's degr 's degr	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>places</b> ormation ee LPO I (examination regulation ars in ee (1 major) Mathematic ee (1 major) Physics (202	each (approx. 20 minu of 2, 15 minutes per c English n which the course is ans for teaching-degree progra s (2016) 16)	utes) or andidate) offered and in the su		
a) writt b) oral c) oral Langua Assess credita Allocat  Morklo 300 h Teachin  Referre  Master Master Master	en examir examir ige of a ment o ble for ion of p onal inf ad ed to in e appea 's degr 's degr	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus blaces ormation e e LPO I (examination regulation ars in ee (1 major) Mathematic ee (1 major) Economathe	each (approx. 20 minu of 2, 15 minutes per c inglish n which the course is ns for teaching-degree progra s (2016) 16) ematics (2016)	utes) or andidate) offered and in the su		
a) writt b) oral c) oral d Langua Assess credita Allocat  Worklo 300 h Teachin  Referre  Module Master Master Master Master	en exa examir examin ge of a ment o ble for ion of p mal inf mad ng cycl ed to in 's degr 's degr 's degr	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus <b>places</b> ormation ee LPO I (examination regulation ars in ee (1 major) Mathematic ee (1 major) Physics (202	each (approx. 20 minu of 2, 15 minutes per c inglish n which the course is ns for teaching-degree progra s (2016) 16) ematics (2016) al Physics (2016)	utes) or andidate) offered and in the su ammes)		
a) writt b) oral c) oral Langua Assess credita Allocat  Additio  Worklo 300 h Teachin  Referre Master Master Master Master Master Master	en exa examir examin ge of a ment o ble for ion of p onal inf onal inf onal inf ead ed to in 's degr 's degr 's degr 's degr	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus blaces ormation ee LPO I (examination regulation ars in ee (1 major) Mathematic ee (1 major) Mathematic ee (1 major) Mathematic	each (approx. 20 minu of 2, 15 minutes per c English n which the course is ns for teaching-degree progra s (2016) 16) ematics (2016) al Physics (2016) nal Mathematics (201	utes) or andidate) offered and in the su ammes) 6)	ubsequent semester	
a) writt b) oral c) oral Langua Assess credita Allocat  Worklo 300 h Teachin  Referre  Module Master Master Master Master Master Master Supple	en exar examin ge of a ment o ble for ion of p mal inf ad ad ad ad ad ad ad ad ad ad ad ad ad	mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German or E ffered: In the semester i bonus blaces ormation e LPO I (examination regulation ars in ee (1 major) Mathematic ee (1 major) Mathematic ee (1 major) Mathematic ee (1 major) Mathematic ee (1 major) Computatio	each (approx. 20 minu of 2, 15 minutes per c inglish n which the course is s (2016) 16) ematics (2016) al Physics (2016) nal Mathematics (201 MINT Teacher Educat Education PLUS, Elite	andidate) offered and in the su offered and in the su ammes) 6) ion PLUS, Elite Netw	ubsequent semester	

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

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Module title Abbreviation						
Optimal Control 10-M=VOST-161-m01					1	
Module coordinator				Module offered by		
Dean of Studies Mathematik (Mathema		natics)	tics) Institute of Mathematics			
ECTS Method of grading Only after succ. compl. of n			npl. of module(s)			
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
optima Recomm We reco quired the con Intende The stur rary res Courses V (3) + 1 Module Method a) writte b) oral	Contents         Basics in optimal control of ordinary and partial differential equations, theory of optimal control, conditions for optimality, methods for numerical solution.         Recommended previous knowledge:         We recommend basic knowledge of functional analysis and ordinary differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Ordinary Differential Equations". Knowledge of the contents of the module "Basics in Optimization" may also be useful.         Intended learning outcomes         The student is acquainted with advanced methods in optimal control. He gains the ability to work on contemporary research questions in continuous optimization.         Courses (type, number of weekly contact hours, language – if other than German)         V (3) + Ü (1)         Module taught in: German and/or English         Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)         a) written examination (approx. 6o to 90 minutes, usually chosen) or       b) oral examination of one candidate each (approx. 15 minutes) or         c) oral examination in groups (groups of 2, approx. 10 minutes per candidate)       or					can be ac- nowledge of n contempo-
credita						
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachir	ıg cycl	е				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	appea	urs in				
Master Master Master Master Supple	Module appears in         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Economathematics (2016)         Master's degree (1 major) Mathematical Physics (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)         Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master's wi (2019)	th 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 26 / 349

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

UNIVERSITÄT

WÜRZBURG

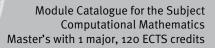
Module title Abbreviation						
Inverse	Inverse Problems 10-M=VIPR-161-m01					
Module coordinator				Module offered by		
Dean of Studies Mathematik (Mathematics) Institute of Mathemati			atics			
ECTS	Metho	od of grading	Only after succ. compl. of module(s)			
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
sation Recom Basic k	methoo mendeo	or equations, ill-posed   ls, examples of ill-pose d previous knowledge: lge of functional analys	d problems.		-	_
ded.		· •				
		ning outcomes		· · · · · · · · · · · · · · · · · · ·		
		an judge whether a give mine them regarding s				
Course	<b>S</b> (type, n	umber of weekly contact hours	s, language — if other than Ger	man)		
V (3) + Module		t in: German and/or En	glish			
		e <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 60 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 15 minu s of 2, approx. 10 minut English	tes) or tes per candidate)	ibsequent semester	
	ion of p					
Additio	onal info	ormation				
Worklo	ad					
150 h						
	ng cycl	2				
	0 . 7	-				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	ins in				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)						
Master's w (2019)	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 28 / 349

Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021)

Module	e title				Abbreviation	
Selected Topics in Numerical and Applied Mathematics					10-M=VNAM-192-m	101
Module coordinator				Module offered by		
Dean of Studies Mathematik (Mathematics)			natics)	Institute of Mathem	atics	
ECTS						
10		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		gladuale				
		· · · · · · ·		1. 1. 1. 1.		
		ussion of a specialised interrelations with othe			taking into account	recent deve-
Depen	ding on	d previous knowledge: the content, basic and	-		of applied mathema	itics is requi-
		doubt, it is recommend	ded to consult the lectu	urer.		
	-	ning outcomes				
		acquainted with advar these to complex proble		ed topic in numerica	l or applied mathem	atics, and is
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ger	man)		
V (4) + Module		t in: German and/or Eng	glish			
Metho	d of ass	sessment (type, scope, lang	uage — if other than German, o	examination offered — if no	t every semester, informati	ion on whether
		le for bonus)				
b) oral c) oral Langua Assess	examir examin age of a	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu s of 2, 15 minutes per c English	ites) or andidate)	ıbsequent semester	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
-	ngavel	0				
Teachi	ing cycl	C				
	1					
Keferre	ea to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
		•				
Module				<u>``</u>		
	-	ee (1 major) Computatio		9)		
	-	ee (1 major) Mathemati ning degree Gymnasiun	-	ion DILIS Elita Noter	ork Bayaria (END) (a	020)
		y course MINT Teacher				020)
		ee (1 major) Mathemati			U) (2020)	
	-	ee (1 major) Economath	•			
	-	ee (1 major) Computatio		2)		
Master's w		r Computational Mathematics	JMU Würzburg • g	enerated 19-Apr-2025 • exam	-	page 30 / 349
2019)			cord Master (120	ECTS) Computational Mather	natics - 2019	

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





## **Subfield Mathematics**

(10 ECTS credits)

Module title Abbreviation						
Topics in Algebra     10-M=AALG-161-m01					1	
Module	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathematics		
ECTS	Metho	od of grading	Only after succ. compl. of module(s)			
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts		·			
algebra Recom	n. mende	topics in algebra, for exa d previous knowledge: lge of algebra is assumed				
"Applie	d Alge	bra".				
Intend	ed lear	ning outcomes				
		acquainted with fundamese skills to complex que		nethods in a contem	porary field of algeb	ra, and is ab-
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) + Module		t in: German and/or Engl	ish			
Metho	d of ass	sessment (type, scope, langua	ge — if other than German, o	examination offered — if no	t every semester, informati	on on whether
		le for bonus)				
b) oral c) oral Langua	examir examin Ige of a ment o	mination (approx. 90 to 1 nation of one candidate e ation in groups (groups o ssessment: German or E ffered: In the semester ir bonus	ach (approx. 20 minu of 2, 15 minutes per c nglish	ites) or andidate)	ibsequent semester	
Allocat	ion of p	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	mmes)		
Module	e appea	ars in				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
	-	ee (1 major) Computation		9)		
	-	ee (1 major) Mathematics	JMU Würzburg ● ge	enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 33 / 349

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

Module title Abbreviation					Abbreviation	
Differential Geometry 10-M=ADGM-161-m01					01	
Module	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathemat			natics)	s) Institute of Mathematics		
ECTS Method of grading Only after succ. compl. of module(s)						
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts	a				
folds. Recom Basic k	mende nowled	dvanced results in diffe d previous knowledge: dge from the modules "				
		is" is recommended. ning outcomes				
		acquainted with conce	ents and methods for d	lifferentiable manifol	ds or Riemannian m	anifolds is
		these methods and kno				
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or En	glish			
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
b) oral c) oral Langua	examir examin Ige of a ment o	mination (approx. 90 to nation of one candidate nation in groups (groups issessment: German or iffered: In the semester bonus	each (approx. 20 mini of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of <sub>l</sub>	places				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Module	e appea	ars in				
Master	's degr	ee (1 major) Mathemati	cs (2016)			
	-	ee (1 major) Physics (20				
	-	ee (1 major) Mathemati				
	-	ee (1 major) Computatio				
		hing degree Gymnasiun ry course MINT Teacher				016)
		r Computational Mathematics		enerated 19-Apr-2025 • exam		page 35 / 349
(2019)				ECTS) Computational Mathem	-	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

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Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Module	e title				Abbreviation	
Comple	ex Anal	ysis			10-M=AFTH-161-mo	1
Module	e coord	inator		Module offered by		
Dean o	fStudi	es Mathematik (Mather	matics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
In-depth study of mapping properties of analytic functions and their generalisations with modern analytic and geometric methods. Structural properties of families of holomorphic and meromorphic functions. Special functi- ons (e. g. elliptic functions). Recommended previous knowledge: Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended.						
Intend	ed lear	ning outcomes				
ticular	the (ge	acquainted with the fu ometric) mapping prop ner acquired skills and	erties of holomorphic f	unctions. He/She is	able to establish a c	onnection
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	rman)		
V (4) + Module		t in: German and/or En	glish			
module is	s creditab	s <b>essment</b> (type, scope, lang le for bonus)			t every semester, informati	on on whether
b) oral c) oral Langua	examir examin age of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu s of 2, 15 minutes per c English	utes) or andidate)	ibsequent semester	
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	immes)		
Module appears in						
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen		page 37 / 349

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Module title					Abbreviation	
Geome	tric Str	uctures			10-M=AGMS-161-m	01
Module	e coord	inator		Module offered by		
Dean o	fStudie	es Mathematik (Mathen	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i i i i i i i i i i i i i i i i i i i		
1 seme	ster	graduate				
Conten	Its					
Tits buildings, generalised polygons or related geometric structures, automorphisms, BN pairs in groups, Mouf- ang conditions, classification results. Recommended previous knowledge: Basic knowledge from the modules "Introduction to Differential Geometry" and "Introduction to Topology" is re- commended.						
Intend	ed learı	ning outcomes				
The stu structu	ıdent is re. He/	acquainted with the fu She is able to establish ractions of geometry ar	a connection betweer	n these results and b	<b>U</b> , 1	-
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ger	rman)		
V (4) + Module		t in: German and/or Eng	glish			
		<b>eessment</b> (type, scope, langu le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ibsequent semester	
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cvcl	6				
	0.7	-				
Referre	d to in	LPO I (examination regulation	ins for teaching-degree progra	ummec)		
Modul	e appea	urs in				
		ee (1 major) Mathematio	cs (2016)			
	-	ee (1 major) Mathemati				
Master's degree (1 major) Mathematical Mysics (2010) Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
	-	ee (1 major) Computatio		-		
Master's w (2019)	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen		page 39 / 349

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

Modul	Module title				Abbreviation	
Indust	rial Sta	tistics 1			10-M=AIST-161-mo:	1
Modul	e coord	inator		Module offered by		
Dean o	of Studio	es Mathematik (Mathei	natics)	Institute of Mathem	natics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ester	graduate				
Conter	nts					
Theory of parameter and domain estimates, tests for statistical estimates, distribution models, empirical distri- bution analysis, comparative analysis, statistical product testing, survey sampling, audit sampling.						
Intend	ed lear	ning outcomes				
The stu	udent m	asters the fundamenta	ll statistical methods fo	or industrial applicat	ions.	
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or En	glish			
		<b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
b) oral c) oral Langua Assess	examir examin age of a	ation of one candidate ation in groups (group ssessment: German or ffered: In the semester	o 120 minutes, usually e each (approx. 20 minu s of 2, 15 minutes per c English in which the course is	utes) or andidate)	ıbsequent semester	
	tion of p					
Additio	onal inf	ormation				
Worklo	ad					
300 h						
-	ng cycl	6				
	3 - )	-				
Referre	ed to in	<b>LPO I</b> (examination regulati	ons for teaching-degree progra	ammes)		
Modul	e appea	urs in				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020)						
Master's w (2019)	vith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 41 / 349

Master's degree (1 major) Economathematics (2021)

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

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

Master's degree (1 major) Mathematical Physics (2022)

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

exchange program Mathematics (2023)

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

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

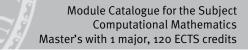
Master's degree (1 major) Economathematics (2024)

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

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

Master's degree (1 major) Economathematics (2025)

Module	Module title				Abbreviation	
Lie The	ory				10-M=ALTH-161-mo	1
Module	coord	inator		Module offered by		
Dean of	fStudie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Linear Lie groups and their Lie algebras, exponential function, structure and classification of Lie algebras, classic examples, applications, e. g. in physics and control theory. Recommended previous knowledge: Basic knowledge of the contents of the modules "Functional Analysis" and "Introduction to Topology" is recom- mended. Furthermore, basic knowledge of the contents of the module "Introduction to Differential Geometry" is useful.						
Intende	ed learr	ning outcomes				
	nese to	acquainted with the fu common problems, an				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (4) + I Module		t in: German and/or Eng	glish			
Method	l of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le for bonus)				
b) oral ( c) oral ( Langua	examin examin ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocati						
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachir	ng cycl	e				
	.5	-				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	mmec)		
		ee (1 major) Mathemati	(2016)			
	-	ee (1 major) Physics (20				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's wi (2019)	tn 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 43 / 349



Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025)

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Module title					Abbreviation	
Control	l Theor	y			10-M=ARTH-161-mo	1
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathe	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts	0				
bility, b Recomi	oasics i mende	n optimal control. d previous knowledge:	s theory: stability, cont ne module "Ordinary Di			ack and sta-
		ning outcomes		•		
The stu blish a and oth	dent is connee ner fiele	acquainted with the function between these reads of mathematics.	indamental notions an sults and broader theor	ries, and learns abou		
		umber of weekly contact hour	s, language — if other than Ger	man)		
V (4) + Module		t in: German and/or En	glish			
Method	d of ass		uage — if other than German, d	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral ( Langua	examir examin ge of a ment o	ation of one candidate ation in groups (group ssessment: German or ffered: In the semester	o 120 minutes, usually o each (approx. 20 minu s of 2, 15 minutes per c English in which the course is	utes) or andidate)	ıbsequent semester	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)		
Module	e appea	ars in				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
	-		onal Mathematics (201	5		
Master's wi (2019)	ith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 45 / 349



Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) Master's degree (1 major) Economathematics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023)

Module	title		Abbreviation				
Stocha	Stochastic Models of Risk Management					01	
Module	coord	inator		Module offered by			
Dean of	fStudi	es Mathematik (Mathen	natics)	Institute of Mathem	natics		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
10		rical grade		•			
Duratio		Module level	Other prerequisites				
1 semes		graduate					
Conten		Siduate					
res, val la, mod estimat series a	Measure theory, risk diagrams, failure mode and effects analysis, risk assessment in auditing, shortfall measu- res, value at risk, conditional value at risk, axiomatic of risk measures, modelling of interdependencies, copu- la, modelling of functional interrelations, regression models, basics in time series modelling, aggregated losses, estimates of shortfall measures, estimates of value at risk and conditional value at risk, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, estimates of value at risk in time series, elementary empirical regression analysis, simulation methods.						
Intende	ed lear	ning outcomes					
The stu	dent is	acquainted with the fu	ndamental methods o	f stochastic risk anal	lysis.		
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Gei	man)			
V (4) + I Module	• •	t in: German and/or Eng	glish				
		sessment (type, scope, langu		examination offered — if no	t everv semester, informati	on on whether	
		le for bonus)			· · · · <b>,</b> · · · · · · · · · · · · · · · · · · ·		
b) oral ( c) oral ( Langua	examir examin ge of a	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester	each (approx. 20 minu of 2, 15 minutes per c English	ıtes) or andidate)	ıbsequent semester		
credita	ble for	bonus	_				
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachir	ng cvcl	e					
	0 . ,	2					
Referre	d to in	<b>LPO I</b> (examination regulation	ns for toaching dogroo progra	mmoc)			
				inities)			
Module	annea	urs in					
			<u> </u>				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016)							
	-	ee (1 major) Mathemati					
Master'	s degr	ee (1 major) Computatio	nal Mathematics (201	6)			
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supple	mentai	y course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2016)		
Master's degree (1 major) Computational Mathematics (2019)							
	-	ee (1 major) Mathemati	cs (2019)				
Master's wi (2019)	th 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 47 / 349	



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

Module title				Abbreviation		
Stocha	istical P	rocesses			10-M=ASTP-161-mo	1
Module	e coordi	nator		Module offered by		
Dean o	of Studie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	d of grading	Only after succ. con	npl. of module(s)		
10	numer	ical grade				
Duratio	on	Module level	Other prerequisites	i i		
1 seme	ster	graduate				
Conten	its					
Markov chains, queues, stochastic processes in C[0,1], Brownian motion, Donsker's theorem, projective limits.						
Basic k	knowled	l previous knowledge: ge of stochastics is rec f the module "Stochast			astics 1" module. Kn	owledge of
		ing outcomes				
The stu	udent is	acquainted with the fu cal problems.	ndamental notions an	d methods of stocha	stical processes and	l can apply
Course	<b>S</b> (type, n	umber of weekly contact hours	s, language — if other than Ge	rman)		
V (4) + Module		in: German and/or Eng	glish			
		<b>essment</b> (type, scope, lang e for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua Assess	examin examin age of as ment of	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester	each (approx. 20 minu s of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
	ble for l					
Allocat	tion of p	laces				
Additio	onal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycle	9				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ummes)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Mathemati	cs (2016)			
	-	ee (1 major) Economath				
	-	ee (1 major) Mathemati				
	-	ee (1 major) Computatio				
		ing degree Gymnasiun				016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019)						
	-	ee (1 major) Mathemati Computational Mathematics		energial in Annual and		
Master's W (2019)	nur i major			enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 49 / 349



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

Module title				Abbreviation		
Topolo	gy				10-M=ATOP-161-mc	)1
Module		instar		Madula offered by		
			matica	Module offered by Institute of Mathem	ation	
-		es Mathematik (Mathe			latics	
ECTS		od of grading	Only after succ. con	ipl. of module(s)		
10		rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
Set-theoretic topology, topological invariants (e.g. fundamental group, connection), construction of topological spaces, covering spaces.						
Intend	ed lear	ning outcomes				
		acquainted with the function of the function o	undamental results, the	orems and methods	in topology and is a	ble to apply
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ger	man)		
V (4) +						
Module	e taugh	t in: German and/or En	glish			
			uage — if other than German, o	examination offered — if no	t every semester, informati	ion on whether
		le for bonus)	 0 120 minutes, usually (			
b) oral c) oral Langua	examir examin age of a ment o	nation of one candidate ation in groups (group ssessment: German or ffered: In the semester	e each (approx. 20 minu s of 2, 15 minutes per c	ites) or andidate)	ıbsequent semester	
Allocat	ion of <b>j</b>	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
-						
Teachi	ing cyci	e				
Referre	ed to in	<b>LPO I</b> (examination regulati	ons for teaching-degree progra	mmes)		
Module	e appea	ars in				
	-	ee (1 major) Mathemat				
	-	ee (1 major) Physics (2				
	-	ee (1 major) Mathemati				
	-		onal Mathematics (201			
			n MINT Teacher Educat			016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)						
Master's degree (1 major) Physics (2020)						
			n MINT Teacher Educat	on PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)
Mastoria	ith a main	r Computational Mathematics	INTL Millionhuse -	anerated to Apr 2025 • over	reg data ro	page 51 / 2/ 2
(2019)	nii i iiaj0			enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 51 / 349

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Module title				Abbreviation			
Insurar	nce Ma	thematics 1			10-M=AVSM-161-m	01	
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathem	atics		
ECTS	Metho	od of grading	Only after succ. con	c. compl. of module(s)			
10	nume	rical grade					
Duratio	n	Module level	Other prerequisites	i			
1 seme	ster	graduate					
Conten	ts						
The module discusses policies on one life: distributions of future lifetime, life tables, life table approximations, types of benefits, present value, expection principle, premium calculation, commutation functions, reserves and policy values, expenses, bonus, recursive methods, Thiele's differential equation. Recommended previous knowledge: Depending on the content, basic and advanced knowledge from different areas of statistics or stochastics is required. In case of doubt, it is recommended to consult the lecturer.							
Intende	ed lear	ning outcomes					
The stu	dent is	acquainted with the fu actical problems.	Indamental notions an	d methods of life ins	urance mathematics	s and can ap-	
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Ge	rman)			
V (4) + Module		t in: German and/or En	glish				
		s <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether	
b) oral c) oral ( Langua	examir examin ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (group ssessment: German or ffered: In the semester bonus	each (approx. 20 minu s of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester		
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
			_				
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	ammes)			
 Modula		vec in					
Module		ee (1 major) Mathemati	cs (2016)				
	-	ee (1 major) Kathemati ee (1 major) Economati					
	-	ee (1 major) Computati		6)			
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Master	Master's degree (1 major) Computational Mathematics (2019)						
Master's wi (2019)	ith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 53 / 349	

Master's degree (1 major) Mathematics (2019)

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

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

Master's degree (1 major) Economathematics (2021)

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

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

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

exchange program Mathematics (2023)

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

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module title				Abbreviation		
Time S	eries A	nalysis 1			10-M=AZRA-161-mc	01
Module	e coord	inator		Module offered by		
Dean o	of Studie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
Additive model, linear filters, autocorrelation, moving average, autoregressive processes, Box-Jenkins method.						
Basic k	nowled	d previous knowledge: lge of stochastics is red f the module "Stochas			astics 1" module. Kn	owledge of
Intend	ed learr	ning outcomes				
The stu proble		acquainted with the fu	indamental methods o	f time series analysis	s and can apply then	n to practical
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Gei	rman)		
V (4) + Module		t in: German and/or En	glish			
		<b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu s of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of p	olaces				
	-					
Additio	onal info	ormation				
Worklo	ad					
300 h						
-	ng cycl	2				
	ing cycl	•				
Roforro	ad to in	LPO I (examination regulation	ans for toaching dogroo progra	immoc)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Mathemati	cs (2016)			
Master's degree (1 major) Economathematics (2016)						
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019)						
	•	ee (1 major) Mathemati			www.data	
Master's w (2019)	iiii 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 55 / 349



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

Module	Module title				Abbreviation	
Numbe	r Theor	у			10-M=AZTH-161-mo	1
Module	coord	inator		Module offered by		
Dean of	fStudie	es Mathematik (Mathen	natics)	ics) Institute of Mathematics		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten	ts		-			
Number-theoretic functions and their associated Dirichlet series resp. Euler products, their analytic theory with applications to prime number distribution and diophantine equations; discussion of the Riemann hypothesis, overview of the development of modern number theory. Recommended previous knowledge: Basic knowledge of algebra and number theory is assumed, such as can be acquired in the modules "Introducti- on to Algebra", "Introduction to Number Theory" and "Applied Algebra".						
		ning outcomes		_		
The stu structu	dent is res in n	acquainted with the fu umber theory and know evelopments in numbe	vs methods for the sol			
Courses	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	rman)		
V (4) + Í Module		t in: German and/or Eng	glish			
Method	l of ass	essment (type, scope, langu	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le for bonus)				
b) oral ( c) oral ( Langua	examin examin ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ibsequent semester	
Allocati						
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachir	ng cvcl	9				
	0 . ,	-				
Referre	d to in	<b>LPO I</b> (examination regulation	ins for teaching-degree progra	mmes)		
 Module appears in						
		ee (1 major) Mathematio	rs (2016)			
	-	ee (1 major) Physics (20				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master's wi (2019)	th 1 majoi	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 57 / 349

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

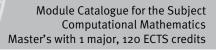
Master's degree (1 major) Computational Mathematics (2024)

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

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

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

Module	Module title				Abbreviation		
Giovan	ni Prod	li Lecture (Master)			10-M=AGPCin-152-r	n01	
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mathe	natics)	atics) Institute of Mathematics			
ECTS		od of grading	Only after succ. con	pl. of module(s)			
5		rical grade					
Duratio		Module level	Other prerequisites				
1 seme							
		graduate					
Conten							
			mathematics by an int	ernational expert.			
Intend	Intended learning outcomes						
themat	tics. He		Indamental concepts a Th a connection betwee Subjects.				
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	rman)			
V (3) + Module		t in: English					
Metho	d of ass		uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether	
c) oral Langua	examin age of a ment o	ation in groups (group ssessment: English ffered: In the semester	e each (approx. 15 minu s of 2, approx. 10 minu in which the course is	tes per candidate)	ıbsequent semester		
Allocat							
Additio	onal inf	ormation					
Worklo	ad						
150 h		-					
Teachi	iig tyti	e					
Referre	ed to in	LPOI (examination regulati	ons for teaching-degree progra	mmes)			
Module	e appea	urs in					
Master	's degr	ee (1 major) Mathemat	cs International (2015)				
	-	ee (1 major) Mathemat					
	-	ee (1 major) Mathemati	-				
Master's degree (1 major) Computational Mathematics (2016)							
	-		onal Mathematics (201	9)			
	-	ee (1 major) Mathemati					
	Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Mathematics International (2021)						
	-						
Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)							
Master's degree (1 major) Mathematics (2022)							
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 59 / 349	



Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics International (2025) Master's degree (1 major) Mathematical Data Science (2025)

Module title					Abbreviation		
Selected Topics in Analysis 10-M=VANA-161-m01						)1	
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathemat			atics)	Institute of Mathematics			
ECTS	Metho	od of grading	Only after succ. compl. of module(s)				
10 numerical grade							
Duration Module level Other prerequisites							
1 semester graduate							
Contents							
with ot Recom Depend	her ma mende ding on	ussion of a specialised to thematical concepts. d previous knowledge: the content, basic and commended to consult t	advanced knowledge				
Intend	ed lear	ning outcomes					
The stu comple		acquainted with advan lems.	ced results in a select	ed topic in analysis,	and is able to apply	these to	
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Ger	rman)			
V (4) + Module		t in: German and/or Eng	lish				
Metho	d of ass	<b>Sessment</b> (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	on on whether	
		le for bonus)					
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus							
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
			_				
Worklo	ad						
300 h							
Teachi	ng cycl	۵	_				
		•					
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)							
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 61 / 349	

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Select	e title				Abbreviation	
Selected Topics in Financial Mathematics 10-M=VFNM-161-m01						01
Module coordinator				Module offered by		
Dean of Studies Mathematik (Mathematics)				Institute of Mathem	atics	
ECTS		od of grading	E C			
	1			Only after succ. compl. of module(s)		
10     numerical grade        Duration     Modula laval     Other processifiers						
			Other prerequisites	•		
1 seme		graduate				
Conten						
of asse stocha Recom Familia	et pricin stic int mende arity wit	es in financial mathema og in discrete time for fi egration, stochastic dif d previous knowledge: h the contents of the m recommended.	nite spaces, American ferential equations and	put, Snell envelope, I Ito calculus, Black-	stopping time, optin Merton-Scholes mod	mal stopping, del.
		ning outcomes				
		acquainted with adva		al mathematics. He/S	he gains the ability	to work on
		research questions in			- ,	
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (4) +	Ü (2)					
Module	e taugh	t in: German and/or En	glish			
Metho	d of ass	<b>sessment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informat	tion on whether
module is	s creditab	le for bonus)				
c) oral	examin	nation of one candidate nation in groups (group	s of 2, 15 minutes per c	,		
	ment o	ssessment: German or ffered: In the semester bonus		offered and in the su	ıbsequent semester	r
Assess	ment o ble for	ffered: In the semester bonus		offered and in the su	ıbsequent semester	r
Assess credita	ment o ble for	ffered: In the semester bonus		offered and in the su	ibsequent semester	r
Assess credita Allocat	ible for t <b>ion of</b>	ffered: In the semester bonus		offered and in the su	ibsequent semester	r
Assess credita Allocat	ible for t <b>ion of</b>	ffered: In the semester bonus <b>places</b>		offered and in the su	ibsequent semester	r 
Assess credita Allocat  Additic	ment o ble for tion of p	ffered: In the semester bonus <b>places</b>		offered and in the su	ibsequent semester	r
Assess credita Allocat  Additic	ment o ble for tion of p	ffered: In the semester bonus <b>places</b>		offered and in the su	ibsequent semester	r
Assess credita Allocat  Additio  Worklo 300 h	ment o ble for tion of p onal inf	ffered: In the semester bonus places ormation		offered and in the su	ibsequent semester	r
Assess credita Allocat  Additic  Worklo	ment o ble for tion of p onal inf	ffered: In the semester bonus places ormation		offered and in the su	ibsequent semester	r
Assess credita Allocat  Additic  Worklo 300 h Teachin	ment o ble for tion of p onal inf pad	ffered: In the semester bonus places ormation e	in which the course is		ibsequent semester	r
Assess credita Allocat  Additic  Worklo 300 h Teachin	ment o ble for tion of p onal inf pad	ffered: In the semester bonus places ormation	in which the course is		ibsequent semester	r
Assess credita Allocat  Additic  300 h Teachin  Referre	ment o ble for tion of p onal inf pad	ffered: In the semester bonus places formation e e LPOI (examination regulati	in which the course is		ibsequent semester	r
Assess credita Allocat  Additio  300 h Teachin  Referre  Module	ed to in	ffered: In the semester bonus places ormation e LPO I (examination regulati ars in	in which the course is		ibsequent semester	r
Assess credita Allocat  Additic 300 h Teachin  Referre  Module	ed to in e appea	ffered: In the semester bonus places ormation ee LPO I (examination regulati ars in ee (1 major) Mathemati	in which the course is		ibsequent semester	r
Assess credita Allocat  Additic  Worklo 300 h Teachin  Referre Modulo Master Master	ed to in e appea	ffered: In the semester bonus places ormation e LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Economath	in which the course is ons for teaching-degree progra cs (2016) nematics (2016)	ammes)	ibsequent semester	r
Assess credita Allocat  Additic  Worklo 300 h Teachin  Referre  Module Master Master Master	ed to in e appea d's degr d's degr	ffered: In the semester bonus places ormation e LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Economath ee (1 major) Computation	in which the course is	ammes) 6)		
Assess credita Allocat  Additic  Worklo 300 h Teachi  Referre  Module Master Master Master Master	ed to in e appea d's degr d's degr d's degr d's teac	ffered: In the semester bonus places ormation e LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Economath	in which the course is	ammes) 6) ion PLUS, Elite Netwo	Drk Bavaria (ENB) (2	
Assess credita Allocat  Additic  Worklo 300 h Teachin  Referre Module Master Master Master Supple	ed to in e appea d's degr 's degr 's teac ementa	ffered: In the semester bonus places ormation e LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Economath ee (1 major) Computation hing degree Gymnasiur	in which the course is ons for teaching-degree progra cs (2016) nematics (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite	ammes) 6) ion PLUS, Elite Netwo Network Bavaria (EN	Drk Bavaria (ENB) (2	

Master's degree (1 major) Mathematics (2019)

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

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

Master's degree (1 major) Economathematics (2021)

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

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

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

exchange program Mathematics (2023)

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

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module title					Abbreviation		
Groups and their Representations 10-M=VGDS-161-m01						01	
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics) Institute of Mathematics			atics				
ECTS	S Method of grading Only after succ. compl. of module(s)						
10 numerical grade							
Duration Module level Other prerequisites							
1 semester graduate							
Contents							
the S-ri Recom	ngs of mende nowled	d previous knowledge: lge of algebra is assum					
	_	ning outcomes					
The stu	dent m	asters advanced algeb questions in group theo					
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Gei	rman)			
V (4) + Module		t in: German and/or Eng	glish				
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, information	on on whether	
a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus							
Allocat	ion of <sub>l</sub>	olaces					
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
	,						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module	e appea	ars in					
Master's degree (1 major) Mathematics (2016)							
Master	's degr	ee (1 major) Physics (20	916)				
	-	ee (1 major) Mathemati	•				
	-	ee (1 major) Computatio					
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)         Master's with 1 major Computational Mathematics       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-       page 65 / 349							
Master's wi (2019)	iin 1 majo	r computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 65 / 349	

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Module title					Abbreviation	
Industrial Statistics 2 10-M=VIST-161-m01						1
Module coordinator				Module offered by	odule offered by	
Dean of Studies Mathematik (Mathematics)			matics)	Institute of Mathem	atics	
ECTS	1	· · · · · · · · · · · · · · · · · · ·	Only after succ. compl. of module(s)			
10     numerical grade        Duration     Module level     Other prerequisites						
		Module level	Other prerequisites			
1 semester graduate						
Conten						
ling, ba	asics in		nonlinear regression, ex analysis, methods of ex g.			
Intend	ed lear	ning outcomes				
The stu	udent m	asters advanced statis	stical methods for indu	strial applications.		
			s, language — if other than Ge			
V (4) +		· · · · · · · · · · · · · · · · · · ·				
		t in: German and/or En	glish			
		s <b>essment</b> (type, scope, lang	guage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
b) oral c) oral Langua Assess	examir examir age of a ment o	nation of one candidate nation in groups (group ssessment: German or ffered: In the semester	o 120 minutes, usually e each (approx. 20 minu s of 2, 15 minutes per c English r in which the course is	utes) or andidate)	ıbsequent semester	
	ble for					
Allocal	ion of	places				
Additio	onal inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regulati	ons for teaching-degree progra	immes)		
Module	e appea	ars in				
		ee (1 major) Mathemat	ics (2016)			
	-	ee (1 major) Economatl				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
		,	n MINT Teacher Educat Education PLUS, Elite			016)
		•	onal Mathematics (201		,	
Master's degree (1 major) Mathematics (2019)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 67 / 349

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

Module title Abbreviation							
Statistical Analysis 10-M=VSTA-161-m01							
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathema			natics)	Institute of Mathematics			
ECTS	CTS Method of grading Only after succ. compl. of module(s)						
10 numerical grade							
Duration Module level Other prerequisites							
1 semester graduate							
Contents							
crimina Recom Basic k	mende mowled	ables, categorical regre tion analysis, cluster a d previous knowledge: lge of stochastics is rec of the module "Stochas	nalysis, principal comp quired, such as that acc	ponent analysis, fact quired in the "Stocha	or analysis.		
		ning outcomes					
	udent is	acquainted with the fu	indamental methods ir	statistical analysis	and can apply them	to practical	
Course	<b>S</b> (type, n	umber of weekly contact hour	5, language — if other than Gei	man)			
V (4) + Module		t in: German and/or En	glish				
	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, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, 15 minutes per candidate) Language of assessment: German or English Assessment offered: In the semester in which the course is offered and in the subsequent semester creditable for bonus							
Allocat	ion of p	olaces					
Additio	onal inf	ormation					
Worklo	ad						
300 h							
-	ng cycl	e					
	<u> </u>						
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Master's degree (1 major) Computational Mathematics (2019)							
Master's w (2019)	ith 1 majoı	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 69 / 349	

Master's degree (1 major) Mathematics (2019)

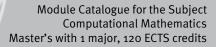
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020)

Module title					Abbreviation		
Insurance Mathematics 2 10-M=VVSM-161-mo1					01		
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			natics)	cs) Institute of Mathematics			
ECTS	Metho	od of grading	Only after succ. compl. of module(s)				
10	o numerical grade						
Duration Module level Other prerequisites							
1 semester graduate							
Conten	ts						
This module discusses modern valuation approaches and multiple decrement models regarding one life or two lives: modern valuation in life insurance mathematics, axiomatic derivation of the product measure approach, Markov chain models, Kolmogorov's differential equations, Thiele's differential equations, numerical applicati- ons, joint life policies. Recommended previous knowledge: Familiarity with the contents of the modules "Insurance Mathematics 1" and "Selected Topics in Financial Mathe-							
matics'	' is stro	ongly recommended.					
		ning outcomes					
		acquainted with advar research questions in i					
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)			
	V (4) + Ü (2) Module taught in: German and/or English						
Method	d of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
module is	creditab	le for bonus)					
b) oral c) oral Langua	examin examin ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester		
Allocat							
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Economathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Master's wi (2019)	п 1 тајој	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 71 / 349	

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

Module title				Abbreviation		
Time S	eries A	nalysis 2			10-M=VZRA-161-mc	)1
Modul	e coord	inator		Module offered by		
Dean c	of Studi	udies Mathematik (Mathematics) Institute of Mathema			atics	
ECTS		od of grading	Only after succ. con			
10		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
		graduate				
<b>Contents</b> State-space models, Kalman filter, frequency spaces, Fourier analysis, periodograms, characterisation of autoco-						
	ce funct		equency spaces, Fourie	er analysis, periodog	rams, characterisati	on of autoco-
Intend	ed lear	ning outcomes				
		acquainted with adva earch questions in this	nced methods in time s field.	series analysis. He ga	ains the ability to wo	ork on con-
Course	<b>es</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (4) +						
1		t in: German and/or En				
		s <b>essment</b> (type, scope, lang Ile for bonus)	guage — if other than German,	examination offered — if no	ot every semester, informati	ion on whether
Langua Assess	age of a	ssessment: German or ffered: In the semester	s of 2, 15 minutes per c English in which the course is		ubsequent semester	
Alloca	tion of <sub>l</sub>	olaces				
Additio	onal inf	ormation				
Worklo	bad					
300 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	ammes)		
	_					
Modul	e appea	ars in				
Master	r's degr	ee (1 major) Mathemat	ics (2016)			
Master	r's degr	ee (1 major) Economatl	nematics (2016)			
	-	ee (1 major) Mathemat	•			
	-		onal Mathematics (201			
1			n MINT Teacher Educat			016)
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)					
	-	ee (1 major) Mathemati				
	-		n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)
Supple	ementa	ry course MINT Teacher	Education PLUS, Elite	Network Bavaria (EN	B) (2020)	
Master's w (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 73 / 349





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

Module title			Abbreviation			
Dynam	ical Sy	stems			10-M=VDSY-161-mc	)1
Modul	e coord	inator		Module offered by		
Dean c	of Studie	es Mathematik (Mathen	natics)	Institute of Mathem	atics	
ECTS	1	od of grading	Only after succ. con			
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts	0				
Fundamentals of dynamical systems, e.g. stability theory, ergodic theory, Hamiltonian systems.						
		d previous knowledge: lge of the contents of th	e module "Ordinary D	ifferential Equations'	' is useful.	
Intend	ed learı	ning outcomes				
	udent m	asters the mathematica	al methods in the theo	ry of dynamic system	ns, and is able to ana	alyse their
		umber of weekly contact hours		rman)		
V (3) +	Ü (1)			illally		
		t in: German and/or Enទ្				
		s <b>essment</b> (type, scope, langu le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 60 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 15 minu of 2, approx. 10 minu English	tes) or tes per candidate)	ıbsequent semester	
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
150 h						
	ng cycl	٩				
reaction	iis cycl					
Deferre				<b>`</b>		
Referre		LPO I (examination regulation	ns for teaching-degree progra	immes)		
		•				
	e appea		( )			
	-	ee (1 major) Mathematic				
	-	ee (1 major) Economath ee (1 major) Mathematio				
	-	ee (1 major) Mathematic		6)		
	-	ning degree Gymnasium			ork Bavaria (ENB) (20	016)
						-,
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						
	-	ning degree Gymnasium	-	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)
		Computational Mathematics	JMU Würzburg • g	enerated 19-Apr-2025 • exam ECTS) Computational Mathen	. reg. data re-	page 75 / 349

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Master's degree (1 major) Mathematical Physics (2022)

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

exchange program Mathematics (2023)

UNIVERSITÄT

WÜRZBURG

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

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

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module title				Abbreviation		
Mather	natical	Imaging			10-M=VMBV-161-m0	01
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Mathematical fundamentals of image processing and computer vision such as elementary projective geometry, camera models and camera calibration, rigid and non-rigid registration, reconstruction of 3D objects from camera pictures; algorithms; module might also include an introduction to geometric methods and tomography. Recommended previous knowledge: Basic knowledge of functional analysis, such as that taught in the module "Functional Analysis", is recommended.						
Intende	ed lear	ning outcomes				
	dent m	asters the mathematic	al methods in the theo	ry of image processi	ng and knows about	their main
Course	<b>S</b> (type, r	umber of weekly contact hours	, language — if other than Ger	man)		
V (3) + Module		t in: German and/or En	glish			
		<b>eessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informatio	on on whether
b) oral c) oral ( Langua	examir examin ge of a ment o	mination (approx. 60 to lation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 15 minu of 2, approx. 10 minu English	tes) or tes per candidate)	bsequent semester	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	irs in				
Master	's degr	ee (1 major) Mathemati ee (1 major) Mathemati				
	-		•	6)		
Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master	's degr	ee (1 major) Computatio	onal Mathematics (201	9)		
Master's wi (2019)	ith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 77 / 349

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Module	Nodule title			Abbreviation		
Selecte	ed Topi	cs in Control Theory			10-M=VTRT-161-mo	1
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Selected topics in linear and non-linear control theory, e.g. networked linear control systems, controllability of bilinear systems.						
		d previous knowledge: the contents of the mo	dule "Mathematical Co	ntrol Theory" or "Cor	ntrol Theory" is requi	red
		ning outcomes				icu.
The stu	dent g	ains insight into conten this field and can apply			/. He/She masters a	dvanced
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or En	glish			
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua	examir examin Ige of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat						
Allocal		Jaces				
 A J J!4! -						
Additio	nat inf	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	urs in				
		ee (1 major) Mathemati	cs (2016)			
	-	ee (1 major) Economath				
	-	ee (1 major) Mathemati				
	-	ee (1 major) Computatio				
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019)						
	-	ee (1 major) Mathemati		an available Arrise		
Master's wi (2019)	ші і шајо	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 79 / 349

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

Module title			Abbreviation			
Non-lir	near Ana	alysis			10-M=VNAN-161-m	01
Module	e coordi	nator		Module offered by		
Dean o	of Studie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	d of grading	Only after succ. con	npl. of module(s)		
5	numer	ical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
Methods in nonlinear analysis (e.g. topological methods, monotony and variational methods) with applications.						
We rec	ommen		unctional analysis and unctional Analysis" an			an be acqui-
Intend	ed learr	ing outcomes				
The stu	udent is		oncepts of non-linear a	nalysis, can compare	e them and assess t	heir applica-
Course	<b>S</b> (type, n	umber of weekly contact hours	s, language — if other than Gei	rman)		
V (3) + Module		in: German and/or En	glish			
		<b>essment</b> (type, scope, lang e for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
b) oral c) oral Langua Assess	examin examin age of a	ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester	9 90 minutes, usually c each (approx. 15 minu s of 2, approx. 10 minu English in which the course is	tes) or tes per candidate)	ıbsequent semester	
	ion of p					
Additio	nal info	ormation				
Worklo	ad					
150 h	/44					
-	ng cycle					
	ing cycli	•				
Referre	d to in	<b>IPOI</b> (examination regulation	ons for teaching-degree progra	mmec)		
				inities)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Mathemati	cs (2016)			
Master	's degre	ee (1 major) Economath	iematics (2016)			
	-	ee (1 major) Mathemati	•			
Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Computational Mathematics (2019)						
	-	ee (1 major) Mathemati			www.data	
Master's w (2019)	iiii i major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 81 / 349



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

Module title				Abbreviation		
Netwo	rked Sy	stems			10-M=VVSY-161-mo	1
Module	e coord	inator		Module offered by		
Dean o	of Studie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Its					
Contemporary topics in networked linear and non-linear dynamical systems (homogenous and non-homogenous systems); analysis of control-theoretical aspects (controllability, accessibility, etc.). Recommended previous knowledge:						
Basic k	nowled	lge of the contents of th	e module "Ordinary D	ifferential Equations'	" is useful.	
Intend	ed learr	ning outcomes				
		acquainted with advar ary research questions			tems. He gains the a	bility to work
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	man)		
V (3) + Module	• •	t in: German and/or Eng	glish			
		<b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 60 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 15 minu of 2, approx. 10 minu English	tes) or tes per candidate)	ıbsequent semester	
	ion of p					
Additio	nalinf	ormation				
Additio	matim					
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Mathemati	cs (2016)			
	-	ee (1 major) Mathemati	•			
	-	ee (1 major) Computatio				
		ning degree Gymnasium				D16)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)						
	-			9)		
	Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)					
		Computational Mathematics		enerated 19-Apr-2025 • exam		page 83 / 349
(2019)				ECTS) Computational Mathen		

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Module title				Abbreviation			
Comple	ex Geoi	netry			10-M=VKGE-161-mc	)1	
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mathen	natics)	ics) Institute of Mathematics			
ECTS	Metho	od of grading	Only after succ. con	Only after succ. compl. of module(s)			
10		rical grade		•			
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		Sidduite					
The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: Wirtinger calculus, complex structures and complex manifolds, metrics on complex manifolds (e. g. conformal, hermitian, Kähler), differential operators on complex manifolds, classification of complex manifolds. Recommended previous knowledge: Basic knowledge of the contents of the modules "Introduction to Complex Analysis" and " Complex Analysis" or "Geometric Complex Analysis" is recommended.							
	-	ning outcomes					
		nows and masters adva al concepts in this fied					
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ger	rman)			
V (4) + Module		t in: German and/or Eng	glish				
Method	d of ass	<b>sessment</b> (type, scope, langu	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
module is	s creditab	le for bonus)					
b) oral c) oral ( Langua	examir examin Ige of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester		
Allocat	ion of <sub>l</sub>	olaces					
Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cvcl	e					
	0 . )						
Referre	d to in	LPO I (examination regulation	ns for toaching dogroo progra	ummoc)			
				inites)			
Module	annea	ars in					
Module appears in         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Mathematical Physics (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
	Master's degree (1 major) Computational Mathematics (2019)						
Master's wi (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	•	page 85 / 349	

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

Module title				Abbreviation		
Partial	Differe	ntial Equations of Math	ematical Physics		10-M=VPDP-161-mo	1
Module	e coord	nator		Module offered by		
Dean o	f Studie	es Mathematik (Mathem	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	after succ. compl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Elliptic, parabolic, and hyperbolic equations; Laplace equation, heat equation and wave equation as standard examples; initial and boundary value problems; well-posed and ill-posed problems; solution methods; extensi- ons and generalisations; Hilbert space methods; Sobolev spaces and Fourier transforms. Recommended previous knowledge: Basic knowledge from the modules "Ordinary Differential Equations" and "Introduction to Partial Differential Equations" is recommended, as well as basic knowledge of functional analysis.						
Intende	ed learr	ning outcomes				
The stu equatio	ident is ons, as	acquainted with funda well as standard examp er acquired skills and c	oles from mathematica	al physics. He/She is	able to establish a c	
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or Eng	lish			
Metho	d of ass	essment (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		le for bonus)				
b) oral c) oral Langua Assess	examin examin ige of a	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or I ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of p	laces				
Additio	onal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	9				
Referre	ed to in	LPOI (examination regulatio	ns for teaching-degree progra	immes)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Mathematio	cs (2016)			
	-	ee (1 major) Physics (20				
	Master's degree (1 major) Mathematical Physics (2016)					
Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		Computational Mathematics		enerated 19-Apr-2025 • exam		page 87 / 349
(2019)				ECTS) Computational Mathen	-	

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

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

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

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

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

Module	Module title						
Pseudo	Riema	nnian and Riemannian	Geometry		10-M=VPRG-161-mc	01	
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mather	natics)	tics) Institute of Mathematics			
ECTS	Metho	od of grading	Only after succ. con	Only after succ. compl. of module(s)			
10	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	Contents						
nian an map, Ja	nd pseu acobi fi e opera	uilds on the topics cove do-Riemannian manifo elds, comparison theor tors, causal structure o	lds, Levi-Civita connec ems in Riemannian geo	tion and curvature, ទ្ ometry, submanifold	geodesics and the ex s, integration, d'Ale	ponential mbert and	
Advanc Geome	ed kno try". Kr	d previous knowledge: wledge of differential g owledge of the content also recommended.					
Intende	ed lear	ning outcomes					
manifo	lds. He	acquainted with advar /She is able to establis   questions in physics.					
Course	<b>S</b> (type, r	umber of weekly contact hours	, language — if other than Gei	rman)			
V (4) + Module		t in: German and/or En	glish				
		<b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
b) oral c) oral ( Langua	examir examin Ige of a ment o	mination (approx. 90 to lation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester		
Allocat							
 Additio	nal inf	ormation					
Worklo	ad						
300 h							
Teachiı	ng cycl	e					
Referre	d to in	LPOI (examination regulation	ons for teaching-degree progra	immes)			
Module	Module appears in						
	Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016)						
	ith 1 majo	Computational Mathematics	JMU Würzburg • g	enerated 19-Apr-2025 • exam	. reg. data re-	page 89 / 349	
(2019)			cord Master (120	ECTS) Computational Mather	natics - 2019		

Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025)

Module title				Abbreviation		
Functio	onal An	alysis			10-M=AFAN-161-mo	)1
Modul	e coord	inator		Module offered by		
Dean o	of Studie	es Mathematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts					
Banach and Hilbert spaces, bounded operators, principles of functional analysis, further contemporary topics in functional analysis and applications to other fields of mathematics. Recommended previous knowledge:						
Familia	arity wit	h the contents of the m	odule "Advanced Anal	ysis" is strongly reco	mmended.	
Intend	ed learı	ning outcomes				
		acquainted with funda e to apply these skills t		nethods in a contem	porary field of funct	ional analy-
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ger	rman)		
V (4) + Module		t in: German and/or Eng	glish			
Metho	d of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module i	s creditab	le for bonus)				
b) oral c) oral Langua Assess	examin examin age of a	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
	tion of p					
Additio		ormation				
Additio		ormation				
 W1-1-						
Worklo						
300 h						
Teachi	ng cycl	9				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	immes)		
Modul	e appea	irs in				
	-	ee (1 major) Mathemati				
	-	ee (1 major) Mathemati	•	~		
	-	ee (1 major) Computatio				
		ning degree Gymnasiun				D16)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)						
	-			9)		
Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
		Computational Mathematics		enerated 19-Apr-2025 • exam		page 91 / 349
(2019)				ECTS) Computational Mathen		

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

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

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

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

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

Module	Nodule title				Abbreviation	
Applied	l Differ	ential Geometry			10-M=VADG-161-mc	)1
Module	coord	inator		Module offered by		
Dean of	fStudie	es Mathematik (Mathen	natics)	ics) Institute of Mathematics		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
The module builds on the topics covered in module 10-M=ADGM and discusses selected applications of differen- tial geometry, e. g. at the interface of control theory and mechanics (subriemannian geometry), in the smooth op- timisation on manifolds or applications in physics. Recommended previous knowledge: Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential						
		lowledge of the content annian and Riemannia				Aechanics",
		ning outcomes			inended.	
The stu	dent is	acquainted with select ction between his/her a				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	rman)		
V (4) + Module		t in: German and/or Eng	glish			
		s <b>essment</b> (type, scope, langu le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral c) oral e Langua	examin examin ge of a ment o	mination (approx. 90 to lation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	ibsequent semester	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachir	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	immes)		
Module	e appea	nrs in				
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's wi (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 93 / 349

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Computational Mathematics (2019)

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Mathematics (2023)

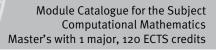
Master's degree (1 major) Computational Mathematics (2024)

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

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

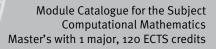
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module	Module title				Abbreviation		
Giovan	ni Prod	li Lecture Selected Top	ics (Master)		10-M=VGPSin-152-r	n01	
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Mathematik (Mathe	matics)	Institute of Mathem	atics		
ECTS	1	od of grading		Only after succ. compl. of module(s)			
10	1	rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		gladuate					
		a a charializad tania in	mathematics by an int	ornational ovnart			
		· · · · ·	mathematics by an int	emational expert.			
		ning outcomes					
themat	The student is acquainted with the fundamental concepts and methods of a contemporary research topic in ma- thematics. He/She is able to establish a connection between his/her acquired skills and other branches of ma- thematics and applications in other subjects.						
Course	<b>S</b> (type, r	number of weekly contact hour	rs, language — if other than Ge	rman)			
V (4) + Module		t in: English					
Metho	d of ass	sessment (type, scope, lang	guage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
		le for bonus)	o 120 minutes, usually	1			
c) oral Langua	examin Ige of a ment o	ation in groups (group ssessment: English ffered: In the semester	e each (approx. 20 minus s of 2, 15 minutes per c r in which the course is	andidate)	ubsequent semester		
Allocat	ion of <sub>l</sub>	olaces					
Additio	onal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
		•	<b>.</b>				
Poforro	d to in		ions for teaching-degree progra				
Referre		LFUI (examination regulat	ions for teaching-degree progra	immes)			
		•					
Module							
	-		ics International (2015)				
	-	ee (1 major) Mathemat ee (1 major) Mathemat					
	-		onal Mathematics (201	6)			
	-		onal Mathematics (201				
	-	ee (1 major) Mathemat		<i>,</i> ,			
	-	ee (1 major) Mathemat	-				
	-	-	ics International (2021)				
	Master's degree (1 major) Computational Mathematics (2022)						
Master's degree (1 major) Mathematics (2022)							
	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam	-	page 95 / 349	
(2019)			cora Master (120	ECTS) Computational Mather	naucs - 2019		



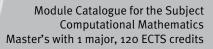
Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics International (2025) Master's degree (1 major) Mathematical Data Science (2025)

Module title Al					Abbreviation		
Giovanni Prodi Lecture Advanced Topics (Master) 10-M=VGPAin-152-mo1					n01		
Module	e coord	inator		Module offered by			
Dean of Studies Mathematik (Mathema		matics)	Institute of Mathem	atics			
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
10		rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		3.44440					
		n a specialised topic in	mathematics by an int	ernational expert			
		ning outcomes					
			 Indamental concepts a	nd mothods of a con	tomporany rocoarch	topic in ma	
themat	tics. He		sh a connection betwee				
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ger	man)			
V (4) +	_						
Module	e taugh	t in: English					
		<b>Sessment</b> (type, scope, lang Ile for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether	
c) oral Langua Assess	examin age of a	ation in groups (group ssessment: English ffered: In the semester	e each (approx. 20 minus s of 2, 15 minutes per c in which the course is	andidate)	ıbsequent semester		
Allocat	ion of <sub>l</sub>	olaces					
Additio	onal inf	ormation					
Worklo	ad						
300 h							
Teachi	ng cycl	e					
Referre	ed to in	<b>LPO I</b> (examination regulati	ons for teaching-degree progra	mmes)			
Module	e appea	ars in					
			cs International (2015)				
	Master's degree (1 major) Mathematics International (2015) Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Mathematical Physics (2016)							
Master's degree (1 major) Computational Mathematics (2016)							
Master's degree (1 major) Computational Mathematics (2019)							
Master's degree (1 major) Mathematics (2019)							
	Master's degree (1 major) Mathematical Physics (2020)						
	Master's degree (1 major) Mathematics International (2021)						
	Master's degree (1 major) Computational Mathematics (2022)						
Master	's degr	ee (1 major) Mathemati	CS (2022)				
	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam	-	page 97 / 349	
(2019)			cord Master (120	ECTS) Computational Mather	natics - 2019		



Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics International (2025)

Module title A					Abbreviation	
Giovanni Prodi Lecture Modern Topics (Master) 10-M=VGPMin-152-mo1					m01	
Module	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathema		matics)	Institute of Mathem	natics		
ECTS		od of grading	Only after succ. con	pl. of module(s)		
10	1	rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		Sidudite				
			mathamatics by an int	amational avaart		
			mathematics by an int	emational expert.		
		ning outcomes				
themat	tics. He		undamental concepts a sh a connection betwee subjects.			
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	man)		
V (4) +						
		t in: English				
		<b>Sessment</b> (type, scope, lang le for bonus)	guage — if other than German,	examination offered — if no	ot every semester, informati	ion on whether
b) oral c) oral Langua Assess	examir examin age of a	nation of one candidate ation in groups (group ssessment: English ffered: In the semester	o 120 minutes, usually e each (approx. 20 minu s of 2, 15 minutes per c in which the course is	utes) or andidate)	ubsequent semester	
	tion of j					
Additio	onal inf	ormation				
Worklo	ad					
300 h						
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Deferme				<b>`</b>		
Referre		LPUT (examination regulation	ons for teaching-degree progra	mmes)		
	e appea					
1	-		ics International (2015)			
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016)						
Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)						
Master's degree (1 major) Mathematical Physics (2020)						
Master's degree (1 major) Mathematical Frysics (2020) Master's degree (1 major) Mathematics International (2021)						
1	Master's degree (1 major) Mathematics international (2021) Master's degree (1 major) Computational Mathematics (2022)					
Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)						
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 99 / 349



Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics International (2025)

Learning by Texching 1       no.04=ELT1-192-m01         Module Giffered by       Institute of Mathematik (Mathematik (Mathematics)       Institute of Mathematiks         Carning       Method of grading       Only after succ. com J. of module(3)         S       (no) successfully completed          Duration       Module of the successfully completed          Some size       graduate          Supervising a tutorial or study group in the Bachelor's programme under guidex successfully completed          Thended Learning outcome          Thended Carning outcome successfully complete in the Bachelor's programme under guidex successfully completed as successfully the in practical situations.          Contrest (upp. number of weekly contact hours, language – if other than German, examination offered – if not every senester, information on whether medide is creditable for bonus.         Assessment for tutoring activities by supervising lecturers or sercise supervisors (s teaching units) Language or assessment: German          Alditonal Instruction with the teaching coordinator for mathematics          Spoin           Refered to In LPO 1 (examination regulations for teaching degree programmes)           set             Master's degree ( maio) Mathematics (2019)	Module tit	tle	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       graduate          Contents           Supervising a tutorial or study group in the Bachelor's programme under guidance of the respective lecturer.       Intended learning outcomes         The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations.          Courses (type, number of weekly contact hours, language – if other than German)       U (2)          Method of passessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for honus)          Assessment of tutoring activities by supervising lecturers or exercise supervisors (a to a teaching units) Language of assessment: German          Additional information            Application and selection with the teaching coordinator for mathematics           Freefot to ILPO I (examination regulations for teaching-degree programmes)	Learning b	by Teaching 1			10-M=ELT1-192-m01	
ECTS       Method of grading       Only after succ. compl. of module(s)         5       (not) successfully completed          1 semester       graduate       Other prerequisites         1 semester       graduate          Contents         Supervising a tutorial or study group in the Bachelor's programme under guidance of the respective lecturer.         Interstudent gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations.         Courses (type, number of weekly contact hours, language – if other than German)         Ü (2)       Wethod of assessment (type, scope, language – if other than German)         Ü (2)       Method for for assessment. German         Additional information         Additional information         Additional information         Application and selection with the teaching coordinator for mathematics         Workload         State of the log of state of the state	Module co	oordinator		Module offered by		
5     (not) successfully completed	Dean of St	tudies Mathematik (Mathem	atics)	Institute of Mathem	atics	
Duration         Module level         Other prerequisites           1 semester         graduate            Contents	ECTS M	ethod of grading	Only after succ. com	pl. of module(s)		
1 semester       graduate          Contents         Supervising a tutorial or study group in the Bachelor's programme under guidance of the respective lecturer.         Intended learning outcomes         The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations.         Courses (type, number of weekly contact hours, language – if other than German)         ① (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)         Assessment of tutoring activities by supervising lecturers or exercise supervisors (a to a teaching units) Language of assessment: German         Allocation of places	5 (n	ot) successfully completed				
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Intended learning outcomes The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations. Courses (type, number of weekly contact hours, language – if other than German) Ü (2) Method of assessment (type, scope, language – if other than German, examination offered – if not every senester, information on whether module is creditable for bonus) Assessment of tutoring activities by supervising lecturers or exercise supervisors (1 to 2 teaching units) Language of assessment: German Allocation of places	Contents	•				
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The student gains his/her first experience in teaching university mathematics. He/She knows basic didactical methods and can apply them in practical situations. Courses (type, number of weekly contact hours, language – if other than German) 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) Assessment of tutoring activities by supervising lecturers or exercise supervisors (1 to 2 teaching units) Language of assessment: German Allocation of places Additional information Application and selection with the teaching coordinator for mathematics Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Computational Mathematics (2024)						
Ú (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)  Assessment of futoring activities by supervising lecturers or exercise supervisors (1 to 2 teaching units) Language of assessment: German  Allocation of places   Additional information  Application and selection with the teaching coordinator for mathematics  Workload  150 h  Teaching cycle   Referred to in LPO I (examination regulations for teaching-degree programmes)   Module appears in  Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computatio		•	-	rsity mathematics. H	e/She knows basic didactical	
Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)         Assessment of tutoring activities by supervising lecturers or exercise supervisors (1 to 2 teaching units) Language of assessment: German         Allocation of places            Additional information         Application and selection with the teaching coordinator for mathematics         Workload         150 h         Teaching cycle            Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Computational Mathematics (2020)         Master's degree (1 major) Computational Mathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathemati	Courses (ty	ype, number of weekly contact hours,	language — if other than Ger	man)		
module is creditable for bonus)         Assessment of tutoring activities by supervising lecturers or exercise supervisors (1 to 2 teaching units) Language of assessment: German         Allocation of places            Additional information         Application and selection with the teaching coordinator for mathematics         Workload         150 h         Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Moster's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Computational Mathematics (2020)         Master's degree (1 major) Computational Mathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computatio	Ü (2)					
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Workload         150 h         Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Computational Mathematics (2020)         Master's degree (1 major) Computational Mathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2024)	Additiona	l information				
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Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Computational Mathematics (2020)         Master's degree (1 major) Computational Mathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         exchange program Mathematics (2023)         Master's degree (1 major) Computational Mathematics (2024)         Master's degree (1 major) Computational Mathematics (2024)         Master's degree (1 major) Computational Mathematics (2024)	Workload					
Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Computational Mathematics (2020)         Master's degree (1 major) Computational Mathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2022)         exchange program Mathematics (2023)         Master's degree (1 major) Computational Mathematics (2024)         Master's degree (1 major) Computational Mathematics (2024)         Master's degree (1 major) Computational Mathematics (2024)	150 h					
Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Mathematical Physics (2020)         Master's degree (1 major) Economathematics (2021)         Master's degree (1 major) Computational Mathematics (2022)         Master's degree (1 major) Mathematical Physics (2022)         Master's degree (1 major) Mathematics (2022)         Master's degree (1 major) Mathematics (2022)         Master's degree (1 major) Computational Mathematics (2024)		cycle	-			
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Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024)						
Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024)						
exchange program Mathematics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024)						
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Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024)	-			4)		
Master's degree (1 major) Economathematics (2024)						
Master's degree (1 major) Economathematics (2025)						

Module title					Abbreviation		
Geome	Geometric Complex Analysis 10-M=VGFT-192-m01					91	
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)		natics)	Institute of Mathem	atics			
ECTS Method of grading Only after succ. compl. of module(s)							
10	nume	rical grade					
Duratio	on	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
trics, q Recom	uasicor mendeo	hods and results in geo formal maps, harmoni d previous knowledge: lge of the contents of th	c functions, biholomor	phic maps).			
				II to complex Analys	is is recommended	•	
		ning outcomes					
able cl	assify tl	acquainted with funda nese results within mor other fields of mathema	e general theories and				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ger	man)			
V (4) + Module		t in: German and/or Eng	glish				
		essment (type, scope, lang le for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether	
b) oral c) oral Langua	examin examin Ige of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	bsequent semester		
Allocat							
Additio	nal inf	ormation					
Additio	matmit						
Worklo	ad						
300 h	uu						
-		-					
Teachi		e					
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)			
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Computational Mathematics (2019)							
Master's degree (1 major) Mathematics (2019)						、 、	
		ning degree Gymnasium				020)	
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
	-	ee (1 major) Mathemati	-	2)			
		ee (1 major) Computatio ee (1 major) Mathematio		۷)			
	-	Computational Mathematics		enerated 19-Apr-2025 • exam	. reg. data re-	page 102 / 349	
(2019)				ECTS) Computational Mathen	-		

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

Module title Abbreviation						
Crypto	Cryptography/Coding Theory 10-M=VKRY-192-m01					
Module	e coord	inator		Module offered by		
Dean of Studies Mathematik (Mathematics)		natics)	Institute of Mathem	atics		
ECTS Method of grading Only after succ. compl. of module(s)						
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts					
rary co Recom	des, bo mende nowleo	n and error correction, l unds, network codes, c d previous knowledge: lge of algebra is assum bra".	connections to cryptog	raphy.		
Intende	ed lear	ning outcomes				
is able	to clas	acquainted with funda sify these results withir phy with other fields of	n more general theories			
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or En	glish			
module is	s creditab	essment (type, scope, lang le for bonus)			t every semester, informati	ion on whether
b) oral c) oral Langua	examir examin Ige of a ment o	mination (approx. 90 to nation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu s of 2, 15 minutes per c English	utes) or andidate)	ıbsequent semester	
Allocat	ion of <sub>l</sub>	olaces				
Additio	nal inf	ormation				
	-					
Worklo	ad					
300 h						
Teachi	ng cycl	e				
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022)						
Master's w (2019)	ии і тајо	computational mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 104 / 349

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

Module title Abbreviation						
Compu	Computer Algebra 10-M=VCAL-192-m01					
Module	e coordi	nator		Module offered by		
Dean of Studies Mathematik (Mathematic		natics)	Institute of Mathem	atics		
ECTS	CTS Method of grading Only after succ. compl. of module(s)					
10	numer	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
lynomia als, syr als, Grö Recom Basic k	als over nbolic i bbner b mendeo nowled	ation of numbers, polyn r finite fields; lattices, la ntegration of rational fu asis, Buchberger's algo d previous knowledge: ge of algebra is assum	attice basis reduction a unctions; exact arithm rithm, algorithms for p	and LLL-algorithm; fa etic with algebraic nu permutation groups.	ictorisation of ration imbers; multivariate	al polynomi- polynomi-
	ed Algeb					
Intende	ed learr	ning outcomes				
The stu puter a		nows about the theoret	ical foundations and th	ne possible applicati	ons of several meth	ods in com-
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	rman)		
V (4) + Module		t in: German and/or Eng	glish			
Metho	d of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le for bonus)				
b) oral c) oral Langua	examin examin Ige of a ment of	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	bsequent semester	
Allocat						
	<u></u>					
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycle	2				
	0 . ,	-				
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020)						
Master's w (2019)	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 106 / 349
(				20.0) computational mathem		

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

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

Master's with 1 major Computational Mathematics (2019)

Module title Abbreviation							
Algorit	Algorithmic Number Theory     10-M=VAZT-192-m01						
Module	coord	inator		Module offered by			
Dean of Studies Mathematik (Mathema		natics)	Institute of Mathematics				
ECTS	Metho	od of grading	Only after succ. con	er succ. compl. of module(s)			
10	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
roots. P tic curv Recomr Basic k	Primalit e meth mendeo nowlec	rs, computation of the y tests for Fermat and <i>I</i> od, quadratic sieve me d previous knowledge: lge of algebra and num ', "Introduction to Num	Mersenne numbers, fac thod), discrete logarith ber theory is assumed	torisation methods ( im. , such as can be acqu	(Pollard-Rho, (p-1)-m	iethod, ellip-	
		ning outcomes					
The stu	dent ki	nows about the theoret er theory.	ical foundations and th	ne possible applicati	ons of several meth	ods in algo-	
Course	<b>S</b> (type, n	umber of weekly contact hours	 5, language — if other than Ger	rman)			
V (4) + I Module		t in: German and/or En	glish				
module is a) writte	creditab en exar	<b>eessment</b> (type, scope, lang le for bonus) mination (approx. 90 to ation of one candidate	120 minutes, usually (	chosen) or	t every semester, informati	ion on whether	
c) oral e Langua	examin ge of a ment o	ation in groups (groups ssessment: German or ffered: In the semester	s of 2, 15 minutes per c English	andidate)	bsequent semester		
Allocat	ion of p	olaces					
Additio	nal info	ormation					
Worklo	ad						
300 h							
Teachir	ng cycl	e					
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	immes)			
Referred to in LPO I (examination regulations for teaching-degree programmes)							
Module	appea	ars in					
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-							
(2019)				ECTS) Computational Mathen	-	P~20 100 / )49	

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

Module title					Abbreviation	
Algebra	Algebraic Geometry 10-M=VAGE-192-mo1					01
Module	e coord	inator		Module offered by		
Dean o	f Studie	es Mathematik (Mathen	natics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
sors an Bezout Recom Basic k	Affine and projective space, affine and projective varieties, morphisms and rational maps; function fields, divi- sors and Riemann-Roch theorem for curves; genus, singularities and Plücker formula; dual curve, dual surface; Bezout's theorem; Grassmann and flag varieties; 27 lines in a cubic surface. Recommended previous knowledge: Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".					
Intende	ed learr	ning outcomes				
classify	these	acquainted with funda results within more ger mathematics.				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (4) + Module		t in: German and/or Eng	lish			
Method	d of ass	<b>essment</b> (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le for bonus)				
b) oral c) oral ( Langua	examin examin ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: German or ffered: In the semester bonus	each (approx. 20 minu of 2, 15 minutes per c English	utes) or andidate)	bsequent semester	
Allocat						
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	9				
	0 . ,	-				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	ummes)		
Module	appea	in in				
Master Master Master Supple Master	Module appears in         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)         Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)         Master's degree (1 major) Mathematical Physics (2020)         Waster's with 1 major Computational Mathematics       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 110 / 349					
(2019)				ECTS) Computational Mathen	-	

Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title Abbreviation					
Interns	ship Ma	thematics			10-M=EPRK-161-m01
Modul	e coord	inator		Module offered by	
Dean o	of Studi	es Mathematik (Mather	matics)	Institute of Mather	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	graduate	In advance, please sor.	consult with a lectur	er who agrees to be your supervi-
Conten	nts				
Work p	laceme	ent in economy, industr	y, research or administ	tration.	
Intend	ed lear	ning outcomes			
		pplies his/her skills ob 1 research, economy or		studies in the maste	r programme to a specific practi-
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ge	rman)	
P (o)					
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if n	ot every semester, information on whether
		report (15 to 30 pages) 60 minutes)	or		
Allocat	tion of <sub>l</sub>	places			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)	
Module	e appea	ars in			
		ee (1 major) Mathemati			
	Master's degree (1 major) Computational Mathematics (2019)				
	-	ee (1 major) Mathemati	-	-)	
Master's degree (1 major) Computational Mathematics (2022)					
Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computational Mathematics (2024)					
	-				



## Subfield Research in Groups and Seminars

(10 ECTS credits)

Module title					Abbreviation	
Resear	Research in Groups - Mathematics in the Sciences					01
Module coordinator Module of			Module offered by	<u> </u>		
Dean o	f Studi	es Mathematik (Mather	matics)	Institute of Mathem	atics	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
10	nume	rical grade				
Duration Module level Other prerequisites						
1 seme	1 semester graduate					
Conten	its					
A mode	ern topi	ic in mathematics in the	e sciences.			
_						
		d previous knowledge: Jge from the modules "	Ordinary Differential Fo	nuations" and "Intro	duction to Partial Dif	ferential
		recommended, as well				lerentiat
Intend	ed lear	ning outcomes		· · · · ·		
The stu	ident g	ains insight into conter	nporary research probl	ems in mathematics	in the sciences. He/	She masters
		nniques in this field and				
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	rman)		
V (2) +						
		t in: German and/or En				
		<b>Sessment</b> (type, scope, lang Ile for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
talk (60	o to 120	o minutes)				
		ssessment: German or				
		ffered: In the semester	in which the course is	offered and in the su	ibsequent semester	
Allocat	ion of <sub>l</sub>	olaces				
Additio	onal inf	ormation				
	-					
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	immes)		
	e appea					
	-	ee (1 major) Mathemati				
	Master's degree (1 major) Mathematical Physics (2016)					
	Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
		ry course MINT Teacher				
Master	's degr	ee (1 major) Computatio	onal Mathematics (201			
	-	ee (1 major) Mathemati	•			,
		hing degree Gymnasiun				)20)
		ry course MINT Teacher ee (1 major) Mathemati		Network Bavaria (EN	ы) (2020)	
	Jucgi					
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 114 / 349

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

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

Module title					Abbreviation	
Research in Groups - Numerical Mathematics and Applied Analysis10-M=GNMA-161-m01						01
Modul	e coord	inator		Module offered by		
Dean o	of Studie	es Mathematik (Mathema	atics)	Institute of Mathen	natics	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
10		rical grade				
Duratio	·	Module level	Other prerequisites			
1 seme		graduate				
Conten						
Selecte	ed topic	s in numerical mathema	tics, applied analysis	or scientific compu	ting.	
Recom	mondo	d previous knowledge:				
		the content, basic and a	advanced knowledge	from different areas	of analysis and/or n	umerical ma
		equired. In case of doubt				americatina
		ning outcomes				
		ains insight into a conter	morany research prof	olems in numerical	mathematics or appl	ied analysis
		ers advanced techniques				ica analysis.
		umber of weekly contact hours,			,	
V (2) +	-	server of meenty contact hours,				
		t in: German and/or Engl	lish			
		sessment (type, scope, langua		examination offered — if n	at avany competer informat	ion on whothor
		le for bonus)	ige — II other than German, e		ot every semester, mormat	
		o minutes)				
		ssessment: German or E	nglish			
Assess	ment o	ffered: In the semester ir	n which the course is	offered and in the s	ubsequent semester	
Allocat	ion of p	olaces				
Additic	nal 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	in in				
		ee (1 major) Mathematics	s (2016)			
	-	ee (1 major) Economathe				
Master's degree (1 major) Mathematical Physics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
		ning degree Gymnasium				016)
		y course MINT Teacher E			B) (2016)	
	-	ee (1 major) Computatior		9)		
	-	ee (1 major) Mathematics	-			)
		ning degree Gymnasium				020)
Supple	mentar	y course MINT Teacher E	aucation PLUS, Elite i	vetwork Bavaria (EN	D) (2020)	
	•••	Computational Mathematics	IMII Würzburg • g	enerated 19-Apr-2025 • exar		
Master's w	ith 1 majoi	computational mathematics		enerateu 19-Apr-2025 • exar	n. reg. data re-	page 116 / 349

UNIVERSITÄT WÜRZBURG Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023)

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

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

Julius-Maxi

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

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

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module	e title				Abbreviation	
Resear	ch in G	roups - Robotics, Optimi	zation and Control Th	neory	10-M=GROC-161-m	01
Module	e coord	inator		Module offered by	<u> </u>	
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	1	od of grading	Only after succ. com			
	1					
10	·	rical grade				
Duratio		Module level	Other prerequisites			
1 semester graduate						
Conten	lts		-			
Selecte	ed mod	ern topics in robotics, op	timisation and contro	ol theory.		
Decom	manda	d provious knowledge.				
		d previous knowledge: the contents of the modu	le "Mathematical Co	ntrol Theory" or "Co	ntrol Theory" is requ	ired
		ning outcomes				
		ains insight into contemp	orary research proble	ems in robotics. opt	mization and contro	l theory. He/
		dvanced techniques in t				,
Course	<b>S</b> (type, n	umber of weekly contact hours, l	language — if other than Ger	man)		
V (2) +						
		t in: German and/or Engl	ish			
Metho	d of ass	<b>essment</b> (type, scope, langua	ge — if other than German, e	examination offered — if no	ot every semester, informat	ion on whether
		le for bonus)				
talk (60	o to 120	minutes)				
		ssessment: German or E				
		ffered: In the semester ir	which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
			-			
Additio	onal info	ormation				
Worklo	ad					
300 h						
<u> </u>	ng cycl	9				
	-3 -9 -10	-				
Doform	d to in		- fauto all'inclui			
Referre		LPOI (examination regulation	s for teaching-degree progra	mmes)		
		•				
	e appea					
	-	ee (1 major) Mathematics				
	-	ee (1 major) Economathe				
	-	ee (1 major) Mathematica ee (1 major) Computation	•	6)		
Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		y course MINT Teacher E				
		ee (1 major) Computation				
	-	ee (1 major) Mathematics		-		
	-	ning degree Gymnasium		ion PLUS, Elite Netw	ork Bavaria (ENB) (2	020)
Supple	mentar	y course MINT Teacher E	ducation PLUS, Elite I	Network Bavaria (EN	B) (2020)	
Master	's degre	ee (1 major) Mathematica	al Physics (2020)			
Master's w	ith 1 maior	Computational Mathematics	IM∐ Wjirzhurg ● ga	enerated 19-Apr-2025 • exam	, reg. data re-	page 118 / 349
		computational mathematics		ECTS) Computational Mather	-	Puse 110 / 349

Master's degree (1 major) Economathematics (2021)

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

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

Master's degree (1 major) Mathematical Physics (2022)

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

exchange program Mathematics (2023)

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

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

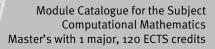
Master's degree (1 major) Economathematics (2024)

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

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

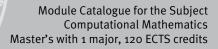
Master's degree (1 major) Economathematics (2025)

Module title					Abbreviation	
Giovan	Giovanni Prodi Seminar (Master)					n01
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS Method of grading Only after succ. compl. of module(s)						
			only arter sace. com			
5		rical grade				
Duration Module level Other prerequisites						
1 seme	1 semester graduate					
Conten	ts					
A mode	ern topi	ic in the research experti	se of the current hold	er of the Giovanni Pr	odi Chair.	
Intende	ed lear	ning outcomes				
		able to elaborate a cont	emporary research to	nic This includes co	mprehending and s	tructuring of
		the available literature, p	. ,	•		-
Course	<b>S</b> (type, r	number of weekly contact hours, I	anguage — if other than Ger	man)		
S (2)		, ,				
	e taugh	t in: English				
		sessment (type, scope, langua	ge — if other than German e	examination offered — if no	t every semester informati	on on whether
		le for bonus)			it every semester, mornal	on on whether
talk (60		o minutes)	-			
		ssessment: English				
		ffered: In the semester ir	which the course is	offered and in the su	ubsequent semester	
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo						
	au					
150 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
	_					
Module	e appea	ars in				
-		ee (1 major) Mathematics	International (2015)			
	-	ee (1 major) Mathematics				
	-	ee (1 major) Economathe				
	-	ee (1 major) Mathematica				
	-	ee (1 major) Computatior	•	6)		
	-	ee (1 major) Computatior				
	-	ee (1 major) Mathematics				
	Master's degree (1 major) Mathematical Physics (2020)					
	Master's degree (1 major) Mathematical Hysics (2020) Master's degree (1 major) Mathematics International (2021)					
Master	's degr	ee (1 major) Economathe	matics (2021)			
	-	ee (1 major) Computatior		2)		
	-	ee (1 major) Mathematics				
	-	ee (1 major) Mathematica				
	-	ee (1 major) Mathematics	•			
		r Computational Mathematics	JMU Würzburg • ge	enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 120 / 349



Master's degree (1 major) Economathematics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Economathematics (2024) Master's degree (1 major) Mathematics International (2025) Master's degree (1 major) Mathematical Data Science (2025) Master's degree (1 major) Economathematics (2025)

Module title					Abbreviation	
Interdisciplinary Seminar 10-M=					10-M=SIDC-161-mo	1
Module	e coord	inator		Module offered by	L	
Dean o	of Studie	es Mathematik (Mathe	matics)	Institute of Mathem	atics	
ECTS	1	od of grading				
5		rical grade				
Duration Module level Other prerequisites						
1 semester graduate						
		glauuale				
Conten		• • • • • • • • • • • • • • • • • • • •				
			interdisciplinary aspec	ts.		
	-	ning outcomes				
			ntemporary research to , preparing a talk and t			
Course	<b>es</b> (type, n	umber of weekly contact hour	s, language — if other than Ge	rman)		
S (2)						
Module	e taugh	t in: German and/or Er	glish			
Metho	d of ass	<b>essment</b> (type, scope, lang	guage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	s creditab	le for bonus)				
		minutes)				
		ssessment: German or		offered and in the cu	head want competer	
	tion of p		in which the course is	onered and in the st		
Additio	onal info	ormation				
Worklo	ad					
150 h						
	ng cycl	•				
Teach	ing cycli	8				
Referre	ed to in	<b>LPOI</b> (examination regulation	ons for teaching-degree progra	immes)		
	e appea					
	-	ee (1 major) Mathemat				
	-	ee (1 major) Economati				
	-	ee (1 major) Mathemat	•			
	-		onal Mathematics (201 n MINT Teacher Educat		ork Rovaria (ENR) (a	216)
		,	Education PLUS, Elite			510)
					D) (2010)	
	Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)					
	-		n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)
			Education PLUS, Elite			
Master	r's degre	ee (1 major) Mathemat	ical Physics (2020)			
	-	ee (1 major) Economat				
	-		onal Mathematics (202	2)		
Master	r's degre	ee (1 major) Mathemat	ics (2022)			
Master's w (2019)	vith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 122 / 349



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

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Julius-Maxi

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

Module title					Abbreviation	
Seminar in Numerical Mathematics and Applied Analysis					10-M=SNMA-161-m	.01
Module	e coord	inator		Module offered by	<u> </u>	
		es Mathematik (Mathe	matics)	Institute of Mathem		
ECTS		od of grading	Only after succ. con		laties	
	1					
5		rical grade				
Duration         Module level         Other prerequisites						
	1 semester graduate					
Conten						
A mode	ern topi	c in numerical mathem	natics or applied analys	sis.		
Decom	manda	d previous knowledge:				
			advanced knowledge	from different areas	of analysis and/or n	umerical ma-
			bt, it is recommended			
		ning outcomes				
		-	ntemporary research to	nic This includes co	mprehending and s	tructuring of
			, preparing a talk and t		. –	-
			s, language — if other than Ge			
S (2)	(t)pt, i					
	e taugh	t in: German and/or En	glish			
			guage — if other than German,	examination offered — if no	nt even comester informat	ion on whether
		le for bonus)	suage in other than German,		it every semester, monnat	ion on whether
talk (60	o to 120	minutes)				
		ssessment: German or	English			
Assess	ment o	ffered: In the semester	in which the course is	offered and in the su	ubsequent semester	,
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo						
	au					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	ammes)		
Module	e appea	rs in				
Master	's degr	ee (1 major) Mathemati	ics (2016)			
Master	's degr	ee (1 major) Economatl	nematics (2016)			
Master	's degr	ee (1 major) Mathemat	ical Physics (2016)			
	-		onal Mathematics (201			
			n MINT Teacher Educat			016)
		•	Education PLUS, Elite		B) (2016)	
	-		onal Mathematics (201	9)		
1	-	ee (1 major) Mathemat	-	ion DILIS Elito Noter	ork Powaria (END) (a	020)
			m MINT Teacher Educat Education PLUS, Elite			020)
Joaphie	mental	y course minur reacher		inclinic Davalla (EIN	U) (2020)	I
Master's w (2019)	ith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 126 / 349

UNIVERSITÄT WÜRZBURG Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Economathematics (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Economathematics (2022) exchange program Mathematics (2023)

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

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

Julius-Maxi

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

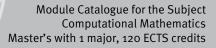
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

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

Master's degree (1 major) Mathematical Data Science (2025)

Master's degree (1 major) Economathematics (2025)

Module title				Abbreviation			
Seminar in Optimization 10-M=SOPT-161-mo1					01		
Modul	e coordi	inator		Module offered by			
Dean c	of Studie	es Mathematik (Mathe	matics)	Institute of Mathem	Mathematics		
ECTS	Metho	od of grading	Only after succ. compl. of module(s)				
5	numei	rical grade					
Durati	on	Module level	Other prerequisites				
1 seme	ester	graduate					
Conter	nts		·				
A mod	ern topi	c in optimisation.					
		ning outcomes					
		-	ntemporary research to	nic This includes co	mprehending and s	tructuring of	
			, preparing a talk and t				
Course	<b>es</b> (type, n	umber of weekly contact hou	rs, language — if other than Ge	rman)			
S (2)							
Modul	e taugh	t in: German and/or Er	ıglish				
Metho	d of ass	essment (type, scope, lang	guage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
module i	is creditab	le for bonus)					
		minutes)					
		ssessment: German or	'English r in which the course is	offered and in the su	ibsoquent comester		
	tion of p			onered and in the st	ibsequent semester		
AllULa		naces					
Additi	onal inf	ormation					
Auditio	onatini		<u>.</u>				
Worklo	oad						
150 h		_					
Teachi	ing cycl	2					
Referre	ed to in	<b>LPO I</b> (examination regulat	ons for teaching-degree progra	immes)			
	e appea						
	-	ee (1 major) Mathemat					
	-	ee (1 major) Economat					
	-	ee (1 major) Mathemat	onal Mathematics (2016)	6)			
	-		n MINT Teacher Educat		ork Bayaria (FNB) (20	o16)	
		·	Education PLUS, Elite			510)	
					_) (_0_0)		
	Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)						
	-	-	m MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)	
		•	Education PLUS, Elite	Network Bavaria (EN	B) (2020)		
	-	ee (1 major) Mathemat					
	-	ee (1 major) Economat		、 、			
	-		onal Mathematics (202	2)			
waster	r s degre	ee (1 major) Mathemat	105 (2022)				
Master's w (2019)	vith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 128 / 349	



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

Module title Abb					Abbreviation	
Seminar Applied Mathematics 10-M=SAMA-192-mc					01	
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mather	natics)	Institute of Mathem	natics	
ECTS	1	od of grading	Only after succ. con	npl. of module(s)		
5		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		gladuate				
		ic in applied mathemat				
A moue	intop	ic în applieu mathemat	105.			
		d previous knowledge:		c		
		the content, basic and doubt, it is recommen			of applied mathema	itics is requi-
		ning outcomes				
				nic This includes co	mprohanding and c	tructuring of
		able to elaborate a cou the available literature,				
		number of weekly contact hours	<u> </u>			
S (2)		· · · · ·		-		
	e taugh	t in: German and/or En	glish			
Method	d of ass	<b>Sessment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether
		le for bonus)				
		o minutes)				
		ssessment: German or		offered and in the set		
		ffered: in the semester	In which the course is	offered and in the st	ubsequent semester	
Allocat	ion of j	Diaces				
Additio	nal inf	ormation	-			
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Module	e appea	ars in				
Master	's degr	ee (1 major) Computatio	onal Mathematics (201	.9)		
	-	ee (1 major) Mathemati	-			
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)					
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)					
	-	ee (1 major) Mathemati	•			
	-	ee (1 major) Economath 20 (1 major) Computati				
	-	ee (1 major) Computatio ee (1 major) Mathemati		22)		
	-	ee (1 major) Mathemati ee (1 major) Mathemati				
	-	ee (1 major) Mathemath	•			
						,
Master's wi (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 130 / 349

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

Master's with 1 major Computational Mathematics (2019)



## Subfield Application Subject

(10 ECTS credits)



## Module Catalogue for the Subject **Computational Mathematics** Master's with 1 major, 120 ECTS credits

# **Application Subject Biology and Medicine**

(ECTS credits)

Module title					Abbreviation	
Bioinfo	Bioinformatics 07-MS2BI-152-m01					
Modul	e coord	inator		Module offered by		
holder	ofthe	Chair of Bioinformatics		Faculty of Biology		
ECTS	Meth	od of grading	Only after succ. compl. of module(s)			
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 semester graduate						
Conter	nts					
Advan	ces and	current results of bioi	nformatics are explaine	d and discussed, thi	is includes results fr	om genome
			ains and protein famili			neration se-
-		· · · · · ·	of different functional	RNAs (e. g. miRNAs,	lncRNAs).	
	-	ning outcomes				
			matics. Discuss their in earch questions in bio	•	advanced (Master)	level know-
Course	<b>es</b> (type, r	number of weekly contact hour	s, language — if other than Gei	man)		
V (2) + Modul		t in: German and/or En	glish			
Metho	d of ass	<b>Sessment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
		le for bonus)	_			
c) oral d) oral	examin examir	ation of one candidate	utes, including multiple each (30 to 60 minute o 3 candidates (30 to 6 d/or English	s) or	or	
Allocat	tion of <sub>l</sub>	olaces				
Additio	onal inf	ormation				
Worklo	bad					
300 h						
	ng cycl	e				
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)		
Modul	e appea	ars in				
		ee (1 major) Biochemis	trv (2015)			
	-	ee (1 major) Biology (20				
1	-	ee (1 major) Mathemat	-			
Master	Master's degree (1 major) Computational Mathematics (2016)					
1	Master's degree (1 major) Biosciences (2016)					
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					016)
		•	Education PLUS, Elite	Network Bavaria (EN	B) (2016)	
1	-	ee (1 major) Bioscience				
	-	ee (1 major) Biochemis ee (1 major) Bioscience				
	-		onal Mathematics (201	<b>a</b> )		
·				-		
Master's w (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 134 / 349

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

Master's degree (1 major) Computer Science (2025)

UNIVERSITÄT

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Module title					Abbreviation		
Bioinformatics F1					07-MS2BIF1-152-mc	)1	
Module coordinator				Module offered by			
holder of the Chair of Bioinformatics			Faculty of Biology				
ECTS Method of grading			Only after succ. con	Only after succ. compl. of module(s)			
10	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts		•				
mics (s proteor	equeno nics), t nalysis	ht into methods in bioir ce-, domain analysis an opological and structur , protein structure analy	d annotation), omics of al analysis of biologica	lata analysis (NGS, tr al interactions includ	ranscriptomics, meta ing statistical metho	abolomics, ods, phyloge-	
Intende	ed lear	ning outcomes					
	e to de	e gained knowledge on sign experiments, colle tice.					
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Gei	man)			
P (14) + Module		t in: German and/or Eng	glish				
		<b>Sessment</b> (type, scope, langu Ile for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether	
<ul> <li>a) written examination (30 to 60 minutes, including multiple choice questions) or</li> <li>b) log (15 to 30 pages) or</li> <li>c) oral examination of one candidate each (30 to 60 minutes) or</li> <li>d) oral examination in groups of up to 3 candidates (30 to 60 minutes) or</li> <li>e) presentation (20 to 45 minutes)</li> <li>Language of assessment: German and/or English</li> </ul>							
Allocat	ion of p	olaces					
Additional information							
Worklo	ad						
300 h							
Teachi	ng cycl	e					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module appears in							
Master's degree (1 major) Biology (2015) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Biosciences (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Biosciences (2017)							
Master's wi (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 136 / 349	

Master's degree (1 major) Biosciences (2018)

UNIVERSITÄT

WÜRZBURG

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

Master's degree (1 major) Biosciences (2021)

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

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

Master's degree (1 major) Biosciences (2023)

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

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

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

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

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

Module title					Abbreviation	
Bioinformatics F2				07-MS2BIF2-152-m	01	
Module coordinator				Module offered by		
holder of the Chair of Bioinformatics				Faculty of Biology		
ECTS Method of grading			Only after succ. con	npl. of module(s)		
15	(not) s	successfully completed				
Duration Module level Other prerequisites						
1 seme	ster	graduate				
Conten	ts					
mics (s proteor netic ar ned and term pa	equeno nics), t nalysis d are m aper.	ght into methods in bio ce-, domain analysis an opological and structur , protein structure analy nodified where necessa	d annotation), omics o al analysis of biologica vsis. The techniques ap	lata analysis (NGS, t al interactions incluc oplied are evaluated	ranscriptomics, meta ling statistical metho on the basis of the p	abolomics, ods, phyloge- results obtai-
Intende	ed lear	ning outcomes				
se a sci	ientific	one or more methods ir project in the field of b arch project and are pre	ioinformatics and to do	ocument the results	obtained. Students	
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ger	rman)		
P (29) + Module		t in: German and/or Eng	glish			
		<b>sessment</b> (type, scope, langu le for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informat	ion on whether
<ul> <li>a) written examination (30 to 60 minutes, including multiple choice questions) or</li> <li>b) log (15 to 30 pages) or</li> <li>c) oral examination of one candidate each (30 to 60 minutes) or</li> <li>d) oral examination in groups of up to 3 candidates (30 to 60 minutes) or</li> <li>e) presentation (20 to 45 minutes)</li> <li>Language of assessment: German and/or English</li> </ul>						
Allocat						
Additional information						
Worklo	ad					
450 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Biology (2015) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Biosciences (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's wi (2019)	th 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	•	page 138 / 349

Master's degree (1 major) Biosciences (2017) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Biosciences (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Biosciences (2023) Master's degree (1 major) Biosciences (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)

Module title					Abbreviation	
Bioinformatics B 07-MBI-					07-MBI-B-152-m01	
Module coordinator				Module offered by		
holder of the Chair of Bioinformatics			Faculty of Biology			
ECTS Method of grading			Only after succ. com			
5	(not) s	successfully completed		-		
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten		0				
and see	quence	current results of bioinfo analysis, protein domai eomics data), analysis o	ns and protein familie	es, large-scale data a	analysis (e. g. net ge	
Intende	ed lear	ning outcomes				
		ecent results in bioinform al technologies and resea			advanced (Master)	level know-
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Ger	man)		
V (2) Module	e taugh	t in: German and/or Engl	ish			
		<b>eessment</b> (type, scope, langua le for bonus)	age — if other than German, e	examination offered — if no	t every semester, informati	on on whether
a) written examination (30 to 60 minutes, including multiple choice questions) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (30 to 60 minutes) Language of assessment: German and/or English						
Allocat	ion of p	olaces				
Additional information						
Workload						
150 h						
Teaching cycle						
Referre	d to in	<b>LPO I</b> (examination regulation	s for teaching-degree progra	mmes)		
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Biology (2015)						
Master's degree (1 major) Biomedicine (2015)						
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's degree (1 major) Biosciences (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Biosciences (2017)						
Master's degree (1 major) Biomedicine (2018)						
Master's degree (1 major) Biosciences (2018) Master's degree (1 major) Computational Mathematics (2010)						
Master's degree (1 major) Computational Mathematics (2019)						
Master's wi (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	_	page 140 / 349

## UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Mathematics (2019)

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

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

Master's degree (1 major) Biosciences (2021)

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

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

exchange program Biosciences (2022)

Master's degree (1 major) Biosciences (2023)

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

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

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

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

Master's with 1 major Computational Mathematics (2019)

Modul	e title	Abbreviation				
Systems Biology 07-MS3S-152-m01						
Module coordinator			Module offered by			
holder	of the Chair of Bioinformatics	5	Faculty of Biology			
ECTS	Method of grading	Only after succ. compl. of module(s)				
10	numerical grade					
Duration Module level Other prerequisites						
1 seme	ester graduate					
Conter		•				
sults fr	ces and current results of con om functional genomics, dyn ulatory networks.					
Intend	ed learning outcomes					
	stand recent results in system of typical technologies and re			an advanced (Maste	r) level know-	
Course	<b>S</b> (type, number of weekly contact hou	rs, language — if other than Ge	rman)			
V (2) + Module	S (1) e taught in: German and/or E	nglish				
	<b>d of assessment</b> (type, scope, lan s creditable for bonus)	guage — if other than German,	examination offered — if no	t every semester, informat	ion on whether	
a) written examination (30 to 60 minutes, including multiple choice questions) or c) oral examination of one candidate each (30 to 60 minutes) or d) oral examination in groups of up to 3 candidates (30 to 60 minutes)						
	age of assessment: German a	nd/or English				
Allocat	tion of places					
	1. 6					
Additio	onal information					
Worklo	Dad					
300 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Biochemistry (2015) Master's degree (1 major) Biology (2015)						
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Biosciences (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Biosciences (2017)						
Master's degree (1 major) Biochemistry (2017)						
	r's degree (1 major) Bioscienc					
Imaster	's degree (1 major) Computat	ional mathematics (201	9)			
Master's w (2019)	ith 1 major Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 142 / 349	

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Biochemistry (2019)

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

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

Master's degree (1 major) Biosciences (2021)

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

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

Master's degree (1 major) Biosciences (2023)

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

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

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

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

Module title					Abbreviation	
System	is Biolo	ogy F1			07-MS3SYF1-152-m	01
Module coordinator				Module offered by		
holder	of the (	Chair of Bioinformatics		Faculty of Biology		
ECTS Method of grading			Only after succ. con	npl. of module(s)		
10	nume	rical grade				
Duratio	'n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	Contents					
ticular, protein	make : structi	course will provide stud students proficient in a ure analysis and proteir tein-protein interactions	dynamical method in s folding, genome anal	systems biology (are ysis and evolution; c	as that may be selectly as that may be selectly as a selec	ted include alysis, the dy-
Intende	ed lear	ning outcomes				
They ar	e able	e gained knowledge on to design scientific rese scientific practice.				
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ger	rman)		
P (14) + Module		t in: German and/or Eng	glish			
		<b>Sessment</b> (type, scope, langu Ile for bonus)	age — if other than German, o	examination offered — if no	t every semester, informati	on on whether
<ul> <li>a) written examination (30 to 60 minutes, including multiple choice questions) or</li> <li>b) log (15 to 30 pages) or</li> <li>c) oral examination of one candidate each (30 to 60 minutes) or</li> <li>d) oral examination in groups of up to 3 candidates (30 to 60 minutes) or</li> <li>e) presentation (20 to 45 minutes)</li> <li>Language of assessment: German and/or English</li> </ul>						
Allocat	ion of p	olaces				
Additional information						
Workload						
300 h						
Teachi	ng cycl	e				
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Biology (2015)						
Master's degree (1 major) FOKUS Life Sciences (2015)						
Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Computational Mathematics (2016)						
Master's degree (1 major) Biosciences (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's wi (2019)	th 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	•	page 144 / 349

Master's degree (1 major) Biosciences (2017) Master's degree (1 major) Biosciences (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Biosciences (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Biosciences (2023) Master's degree (1 major) Biosciences (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module	Nodule title Abbreviation						
System	ıs Biolo	ogy F2			07-MS3SYF2-152-m	01	
Module	e coord	inator		Module offered by	^		
holder	of the (	Chair of Bioinformatics		Faculty of Biology			
ECTS	Metho	od of grading	Only after succ. con	Only after succ. compl. of module(s)			
15	(not) s	successfully completed					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
The practical course will provide students with advanced insights into a field of systems biology and will, in par- ticular, make students proficient in a dynamical method in systems biology (areas that may be selected include protein structure analysis and protein folding, genome analysis and evolution; dynamic network analysis, the dy- namics of protein-protein interactions, modelling cellular regulation; modelling metabolism, statistical model- ling). The techniques applied are evaluated on the basis of the results obtained and are modified where neces- sary. Results are documented in the form of a presentation, a publication or a term paper.							
Intende	ed lear	ning outcomes					
nise a s	scientif	one or more methods i ic project in the field of arch project and are pre	bioinformatics and to	document the result	s obtained. Student		
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)			
P (29) + Module		t in: German and/or En	glish				
module is	creditab	<b>Sessment</b> (type, scope, lang le for bonus)				ion on whether	
b) log ( c) oral e d) oral e) prese	15 to 30 examin examir entatio	mination (30 to 60 min o pages) or ation of one candidate nation in groups of up to n (20 to 45 minutes) ssessment: German an	each (30 to 60 minute 9 3 candidates (30 to 6	s) or	or		
Allocat	ion of J	olaces					
Additio	nal inf	ormation					
Worklo	ad						
450 h							
Teachir	ng cycl	е					
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)			
Module	e appea	ars in					
Master Master Master Master Supple	's degr 's degr 's degr 's teacl menta	ee (1 major) Biology (20 ee (1 major) Mathemati ee (1 major) Computatio ee (1 major) Bioscience hing degree Gymnasium ry course MINT Teacher	cs (2016) onal Mathematics (201 s (2016) n MINT Teacher Educat Education PLUS, Elite	ion PLUS, Elite Netwo Network Bavaria (EN	B) (2016)		
Master's wi (2019)	th 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 146 / 349	

Master's degree (1 major) Biosciences (2017) Master's degree (1 major) Biosciences (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Biosciences (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Biosciences (2023) Master's degree (1 major) Biosciences (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)

Module title Abbreviation						
System	ns Biolo	оду В			07-MS-B-152-m01	
Module	e coord	inator		Module offered by		
holder	ofthe	Chair of Bioinformatics		Faculty of Biology		
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	(not) s	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Advances and current results of computational systems biology are explained and discussed, this includes re- sults from functional genomics, dynamics of the transcriptome, of metabolism and metabolic networks as well as regulatory networks.						
Intende	ed lear	ning outcomes				
		ecent results in systems l al technologies and rese			an advanced (Master	) level know-
Course	<b>S</b> (type, r	number of weekly contact hours,	language — if other than Gei	rman)		
V (2) Module	e taugh	t in: German and/or Eng	lish			
		sessment (type, scope, langua	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		le for bonus)				
c) oral ( d) oral	examin examir	mination (30 to 60 minut ation of one candidate e nation in groups of up to ssessment: German and	ach (30 to 60 minute 3 candidates (30 to 6	s) or	Dr	
Allocat	ion of	places				
Additio	nal inf	ormation	-			
Worklo	ad					
150 h						
Teachi	ng cycl	Δ				
	15 cycl					
Poforro	d to in	LPO I (examination regulation	- four to a chimer do anno a marcan			
Referre		LFUT (examination regulation	is for teaching-degree progra	mmes)		
		•				
Module			<u>``</u>			
	-	ee (1 major) Biology (201 ee (1 major) Biomedicine				
	-	ee (1 major) Mathematics				
	-	ee (1 major) Computation		6)		
	-	ee (1 major) Biosciences				
	-	hing degree Gymnasium		ion PLUS. Elite Netwo	ork Bavaria (ENB) (20	516)
		ry course MINT Teacher E				/
		ee (1 major) Biosciences				
		ee (1 major) Biomedicine				
Master	's degr	ee (1 major) Biosciences	(2018)			
Master	's degr	ee (1 major) Computatior	nal Mathematics (201	9)		
Master's wi	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 148 / 349

### UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Mathematics (2019)

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

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

Master's degree (1 major) Biosciences (2021)

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

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

Master's degree (1 major) Biosciences (2023)

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

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

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

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



## **Application Subject Chemie**

(ECTS credits)

Module	title				Abbreviation	
Laser S	pectro	scopy			08-PCM1a-161-m01	
Module	coord	inator		Module offered by		
		ninar "Laserspektroskop	ie" (Laser Spectros-			
	Metho	od of grading	Only after succ. cor	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites	5		
1 semes	ster	graduate				
Content	ts.	0	<u>J</u>			
This mo	dule ir	ntroduces students to th spectroscopy.	e fundamental princi	ples of laser spectros	scopy. It discusses a	bsorption
Intende	d learı	ning outcomes				
		able to explain the comp plogy. They are able to d				
Courses	<b>5</b> (type, n	umber of weekly contact hours,	language — if other than Ge	rman)		
S (2) + Ü Module	.,	t in: German or English				
Method	of ass	<b>essment</b> (type, scope, langua	age — if other than German,	examination offered — if no	t every semester, informat	ion on whether
module is	creditab	le for bonus)				
b) oral e	examin	nination (approx. 90 min ation of one candidate e ssessment: German and	each (approx. 20 min	utes)		
Allocati	on of p	olaces				
Additio	nal inf	ormation				
Workloa	ad					
150 h						
		•				
Teachin	ig tyti	5				
	J 4 - 1					
Referre	a to in	LPO I (examination regulation	is for teaching-degree progra	ammes)		
Module						
			2246)			
	-	ee (1 major) Chemistry (2 ee (1 major) Mathematic				
	-	ee (1 major) Mathematic		6)		
	-	ee (1 major) Functional N				
	-	ning degree Gymnasium		ion PLUS, Elite Netwo	ork Bavaria (ENB) (2	016)
		y course MINT Teacher E				
		ee (1 major) Chemistry (2				
	-	ee (1 major) Computation		19)		
	-	ee (1 major) Mathematic	-			
		ning degree Gymnasium				020)
		y course MINT Teacher E ee (1 major) Computation			B) (2020)	
Master's wit (2019)	th 1 majoi	Computational Mathematics		generated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 151 / 349

Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

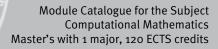
Advand	e title				Abbreviation	
ruvdii(	ced Phy	/sical Chemistry (Lab)			08-PCM1b-161-m01	
Modul	e coord	inator		Module offered by		
		ninar "Laserspektroskor	bie" (Laser Spectros-			
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
5	1	successfully completed		• • • • •		
 Duratio		Module level	Other prerequisites	:		
		_				
1 seme		graduate	<u> </u>			
borato	ry. Afte	rives students the oppor r a safety briefing, the st o take tests and write la	udents autonomously	y conduct experimen	ts in the laboratory.	
Intend	ed lear	ning outcomes				
		e developed a high level		-	thods in physical ch	emistry.
They ar	re able	to analyse the resulting	measurements and w	rite a lab report.		
Course	<b>S</b> (type, I	number of weekly contact hours	, language — if other than Ge	rman)		
P (4)						
Module	e taugh	t in: German or English	_			
Metho	d of as	<b>Sessment</b> (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	ion on whether
module is	s creditat	ole for bonus)				
	age of a	nd assessment of pract issessment: German and <b>places</b>				
Additio		armation				
		ormation	ation, block tought lo			
Additic	onal inf	ormation ormation on module du	ration: block taught la	b course with approx	. 20 working days.	
Additic <b>Worklo</b>	onal inf		ration: block taught la	b course with approx	. 20 working days.	
Additic <b>Worklo</b>	onal inf		ration: block taught la	b course with appro>	<. 20 working days.	
	onal inf oad	ormation on module du	ration: block taught la	b course with approx	. 20 working days.	
Additic <b>Worklo</b> 150 h	onal inf oad	ormation on module du	ration: block taught la	b course with approx	. 20 working days.	
Additic <b>Worklo</b> 150 h <b>Teachi</b>	onal inf oad ng cycl	ormation on module du			4. 20 working days.	
Additic <b>Worklo</b> 150 h <b>Teachi</b>	onal inf oad ng cycl	ormation on module du			x. 20 working days.	
Additic Worklo 150 h Teachin  Referre	onal inf pad ng cycl ed to in	ormation on module du e LPOI (examination regulatio			4. 20 working days.	
Additic Worklo 150 h Teachin  Referre  Modulo	onal inf oad ng cycl ed to in e appea	ormation on module du e LPOI (examination regulatio	ns for teaching-degree progra		x. 20 working days.	
Additic Worklo 150 h Teachin  Referre  Modulo Master	ng cycl ed to in e appea	ormation on module du e LPOI (examination regulatio	ns for teaching-degree progr 2016)		4. 20 working days.	
Additic Worklo 150 h Teachin  Referre  Modulo Master Master	nal inf pad ng cycl ed to in e appea ''s degr	ormation on module du e LPOI (examination regulatio ars in ee (1 major) Chemistry (	ns for teaching-degree progr 2016) 25 (2016)	ammes)	k. 20 working days.	
Additic Worklo 150 h Teachin  Referre  Module Master Master Master	ed to in e appea ''s degr ''s degr	e LPOI (examination regulatio ars in ee (1 major) Chemistry ( ee (1 major) Mathematic	ns for teaching-degree progra 2016) :s (2016) nal Mathematics (201	ammes) .6)		016)
Additic Worklo 150 h Teachi Teachi Referre Master Master Master Supple	ed to in ed to in ed to in d's degr d's degr d's teac ementa	e EPOI (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathematica ee (1 major) Computation hing degree Gymnasium ry course MINT Teacher	ns for teaching-degree progr 2016) 2016) 2016) al Mathematics (201 MINT Teacher Educat Education PLUS, Elite	ammes) .6) ion PLUS, Elite Netw	ork Bavaria (ENB) (20	016)
Additic Worklo 150 h Teachin  Referre  Master Master Master Master Supple Master	ed to in ed to in e appea f's degr f's degr f's degr f's degr f's degr f's degr f's degr	e LPOI (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathematic ee (1 major) Computation hing degree Gymnasium ry course MINT Teacher I ee (1 major) Chemistry (	ns for teaching-degree progra 2016) 2016) 2016) nal Mathematics (201 MINT Teacher Educat Education PLUS, Elite 2018)	ammes) .6) ion PLUS, Elite Netw Network Bavaria (EN	ork Bavaria (ENB) (20	016)
Additic Worklo 150 h Teachin  Referre  Master Master Master Supple Master Master Master	ed to in e appea d's degr d's degr d's teac ementa d's degr d's degr	e LPOI (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathematic ee (1 major) Computation hing degree Gymnasium ry course MINT Teacher ee (1 major) Chemistry ( ee (1 major) Computation ee (1 major) Computation	ns for teaching-degree progra 2016) :s (2016) nal Mathematics (201 MINT Teacher Educat Education PLUS, Elite 2018) nal Mathematics (201	ammes) .6) ion PLUS, Elite Netw Network Bavaria (EN	ork Bavaria (ENB) (20	016)
Additic Worklo 150 h Teachin  Referre Master Master Master Master Supple Master Master Master Master	ed to in e appea d's degr d's degr d's teac ementa d's degr d's degr d's degr d's degr d's degr	e LPOI (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium ry course MINT Teacher ee (1 major) Chemistry ( ee (1 major) Computation ee (1 major) Computation ee (1 major) Computation ee (1 major) Mathemation ee (1 major) Mathemation ee (1 major) Mathemation ee (1 major) Mathemation	ns for teaching-degree progra 2016) 2016) 2016) 2016) 2016) nal Mathematics (201 MINT Teacher Educat Education PLUS, Elite 2018) nal Mathematics (201 2019)	ammes) .6) .ion PLUS, Elite Netw Network Bavaria (EN .9)	ork Bavaria (ENB) (20 B) (2016)	
Additic Worklo 150 h Teachi Teachi Referre Master Master Master Master Supple Master Master Master Master Master Master	ed to in ed to in ed to in ed to in e appea e's degr e's degr e's teac ementa e's degr e's degr e's degr e's degr	e LPO I (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium ry course MINT Teacher I ee (1 major) Chemistry ( ee (1 major) Chemistry ( ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium	ns for teaching-degree progr 2016) 2016) 2016) nal Mathematics (201 MINT Teacher Educat Education PLUS, Elite 2018) nal Mathematics (201 2019) MINT Teacher Educat	ammes) .6) ion PLUS, Elite Network Bavaria (EN .9) ion PLUS, Elite Network	ork Bavaria (ENB) (20 B) (2016) ork Bavaria (ENB) (20	
Additic Workla 150 h Teachin  Referre  Master Master Master Master Supple Master Master Master Supple	ed to in e appea d's degr d's degr d's degr d's teac ementa d's degr d's teac ementa	e LPOI (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathemation ee (1 major) Computation hing degree Gymnasium ry course MINT Teacher I ee (1 major) Chemistry ( ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium ry course MINT Teacher I hing degree Gymnasium ry course MINT Teacher I	ns for teaching-degree progra 2016) 2016) 2016) 2016) nal Mathematics (201 MINT Teacher Educat 2018) nal Mathematics (201 2019) MINT Teacher Educat Education PLUS, Elite	ammes) .6) .ion PLUS, Elite Netw Network Bavaria (EN .9) .ion PLUS, Elite Netw Network Bavaria (EN	ork Bavaria (ENB) (20 B) (2016) ork Bavaria (ENB) (20	
Additic Worklo 150 h Teachin  Referre  Master Master Master Master Master Master Master Master Master Supple Master Supple Master	ed to in ed to in ed to in e appea d's degr d's degr d's teac ementa d's degr d's teac ementa d's degr	e LPO I (examination regulation ars in ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium ry course MINT Teacher I ee (1 major) Chemistry ( ee (1 major) Chemistry ( ee (1 major) Chemistry ( ee (1 major) Mathemation hing degree Gymnasium hing degree Gymnasium	ns for teaching-degree progra 2016) 2016) 2016) al Mathematics (201 MINT Teacher Educat Education PLUS, Elite 2018) nal Mathematics (201 2019) MINT Teacher Educat Education PLUS, Elite nal Mathematics (202	ammes) .6) .ion PLUS, Elite Netw Network Bavaria (EN .9) .ion PLUS, Elite Netw Network Bavaria (EN	ork Bavaria (ENB) (20 B) (2016) ork Bavaria (ENB) (20 B) (2020)	

Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Modul	e title				Abbreviation	
Statist	ical Me	echanics and Reaction I	Dynamics		08-PCM2-161-m01	
Module	e coord	linator		Module offered by	l	
lecture		minar "Chemische Dyna	mik" (Chemical Dyna-	Institute of Physica	l and Theoretical Cł	nemistry
mics)	[					
ECTS	1	od of grading	Only after succ. con	c. compl. of module(s)		
5		rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	nts					
clude t	he fun	liscusses selected topi damental principles of vell as charge and ener	statistical thermodynar			
Intend	ed lear	ning outcomes				
		e become familiar with re able to apply the fur				s. They have
		number of weekly contact hour				
S (2) +			-,			
• • •	• • •	it in: German or English				
		<b>sessment</b> (type, scope, lang ble for bonus)	uage — if other than German, o	examination offered — if no	ot every semester, informa	tion on whether
c) talk Langua	(approz age of a	nation of one candidate x. 30 minutes) issessment: German ar				
Allocat	tion of	places				
Additio	onal inf	ormation				
 Worklo	ad					
150 h						
Teachi	ng cvcl	e				
	0.,					
Referre	d to in	LPO I (examination regulati	ons for teaching degree progra	mmec)		
		arc in				
Modul			(224())			
	-	ee (1 major) Chemistry				
	-	ee (1 major) Mathemati ee (1 major) Computati		6)		
	-	ee (1 major) Functional		0)		
	-	hing degree Gymnasiur		ion PLUS, Flite Netw	ork Bavaria (FNR) (a	2016)
		ry course MINT Teacher				
		ee (1 major) Chemistry			_, ()	
	-	ee (1 major) Computati		9)		
	-	ee (1 major) Mathemati		<i>,</i> ,		
		hing degree Gymnasiur				
			n MINT Teacher Educat	ion PLUS, Elite Netw	ork Bavaria (ENB) (2	2020)
	ith 1 maio	r Computational Mathematics		enerated 19-Apr-2025 • exam		2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Module title Abbreviati					Abbreviation		
Nanoso	ale Ma	terials			08-PCM3-161-m01		
Module	e coord	inator		Module offered by			
lecture	r of the	seminar "Nanoskalige	Materialien"	Institute of Physical and Theoretical Chemistry			
ECTS	r –	od of grading	Only after succ. con			,	
5		rical grade		<u> </u>			
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		Sidduite					
This mo	odule d		oics in nanoscale mater s and application area			es, fabricati-	
		ning outcomes	<u> </u>				
Studen	ts are a	-	noscale materials. They	v are able to name ar	nalytical methods an	d applicati-	
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Ge	rman)			
S (2) + Module		t in: German or English					
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether	
c) talk Langua credita	(approx ge of a ble for	x. 30 minutes) ssessment: German ar bonus	e each (approx. 20 mini Id/or English				
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Worklo	ad						
150 h			_				
Teachi	ng cycl	e					
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	immes)			
Module	e appea	ars in					
Master Master Master Master	Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master Master Master	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Chemistry (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
			Education PLUS, Elite			- /	
Master's w (2019)	ith 1 majo	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 157 / 349	



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

Module	e title				Abbreviation		
Ultrafa	st spec	troscopy and quantum	control		08-PCM4-161-m01		
Module	e coord	inator		Module offered by			
lecture	r of the	seminar "Nanoskalige	Materialien"	Institute of Physical and Theoretical Chemistry			
ECTS	1	od of grading	Only after succ. con	· · ·		ennotry	
			Only alter succ. con				
5		rical grade					
Duratio	on	Module level	Other prerequisites	equisites			
1 seme	ster	graduate	Prior completion of	modules o8-PCM1a	and o8-PCM1b recon	nmended.	
Conten	Its						
		iscusses advanced top ime-resolved laser spec			control. It focuses o	n ultrashort	
Intend	ed lear	ning outcomes					
plain tł princip	ne theo les and	able to describe the gen ry of time-resolved lase I applications of quantu	r spectroscopy and na m control.	me experimental me			
S (2) +	Ü (1)	number of weekly contact hours	, language — if other than Ge	rman)			
		sessment (type, scope, langule for bonus)	age — if other than German,	examination offered — if no	ot every semester, informat	ion on whether	
c) talk Langua	(approx age of a	aation of one candidate (. 30 minutes) ssessment: German an		utes) or			
Allocat	ion of p	olaces					
 • • • ••••			_				
Additio	onal inf	ormation					
Worklo	ad						
150 h							
Teachi	ng cycl	e					
Referre	ed to in	LPOI (examination regulation	ns for teaching-degree progra	ammes)			
				,			
Madul		rc in					
	e appea		2016)				
		ee (1 major) Chemistry ( ee (1 major) Mathematio					
	-	ee (1 major) Mathematic					
	-	ee (1 major) Nanostruct					
	-	ee (1 major) Computatio		6)			
	-	ning degree Gymnasium			ork Bavaria (ENB) (2	016)	
		y course MINT Teacher				-	
		ee (1 major) Chemistry (					
	-	ee (1 major) Computatio		9)			
		ee (1 major) Mathematio					
Master	's degr	ee (1 major) Nanostruct	ure Technology (2020)				
∕laster's w	ith 1 majo	r Computational Mathematics	JMU Würzburg ● g	enerated 19-Apr-2025 • exam	n. reg. data re-	page 159 / 34	
2019)				ECTS) Computational Mather	-		



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

	e title				Abbreviation	
Physic	al Chei	mistry of Supramolecu	ılar Assemblies		08-PCM5-161-m01	
Modul	e coord	linator		Module offered by		
	er of the r Strukt		he Chemie Supramole-	Institute of Physical	and Theoretical Ch	emistry
ECTS		od of grading	Only after succ. con	npl. of module(s)		
5	1	erical grade				
<u> </u>		Module level	Other prerequisites			
1 seme		graduate		·		
Conter		gladdale				
This m	odule e		eractions between mole as key applications of s			ysical-chemi
Intend	ed lear	ning outcomes				
dern a	pplicat <b>es</b> (type, 1	ions of supramolecula	ormation and physical-c r chemistry. ırs, language — if other than Ge		f aggregates. They c	an name mo
Modul	e taugh	nt in: German or Englis	h			
		<b>sessment</b> (type, scope, lar ole for bonus)	nguage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
Langua		x. 30 minutes) assessment: German a <b>places</b>	nd/or English			
Additio	onal inf	ormation				
Worklo	ad					
150 h						
1001						
-	ng cyc	le				
-	ng cyc	le				
Teachi			tions for teaching-degree progra	ammes)		
Teachi			tions for teaching-degree progra	ammes)		
Teachi  Referre	ed to in	LPOI (examination regula	tions for teaching-degree progra	ammes)		
Teachi  Referre  Module	ed to in e appea	I LPO I (examination regula		ammes)		
Teachi  Referre  Module Master	<b>ed to in</b> <b>e appe</b> a r's degr	LPOI (examination regula	/ (2016)	ammes)		
Teachi  Referre  Module Master Master	<b>ed to in</b> <b>e appe</b> r's degr r's degr	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema	/ (2016)			
Teachi  Referre  Module Master Master Master Master	ed to in e appea r's degr r's degr r's degr r's degr	ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016)	6)		
Teachi  Referre  Master Master Master Master Master	ed to in e appea r's degr r's degr r's degr r's degr r's degr	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona hing degree Gymnasiu	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016) Im MINT Teacher Educat	6) ion PLUS, Elite Netwo		016)
Teachi  Referre  Master Master Master Master Supple	ed to in e apper r's degr r's degr r's degr r's degr r's teac ementa	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona hing degree Gymnasiu ry course MINT Teache	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016) Im MINT Teacher Educat er Education PLUS, Elite	6) ion PLUS, Elite Netwo		016)
Teachi  Referre  Module Master Master Master Supple Master	ed to in e appea r's degr r's degr r's degr r's degr r's teac ementa r's degr	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona hing degree Gymnasiu ry course MINT Teache ree (1 major) Chemistry	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016) Im MINT Teacher Educat er Education PLUS, Elite / (2018)	6) ion PLUS, Elite Netwo Network Bavaria (ENI		016)
Teachi  Referre  Master Master Master Master Supple Master Master	ed to in e appea r's degr r's degr r's degr r's teac ementa r's degr r's degr	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona hing degree Gymnasiu ry course MINT Teacher ree (1 major) Chemistry ree (1 major) Computat	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016) Im MINT Teacher Educat er Education PLUS, Elite / (2018) tional Mathematics (201	6) ion PLUS, Elite Netwo Network Bavaria (ENI		016)
Teachi  Referre  Master Master Master Master Supple Master Master Master Master	ed to in e appea r's degr r's degr r's degr r's teac ementa r's degr r's degr r's degr	<b>LPO I</b> (examination regula ars in ree (1 major) Chemistry ree (1 major) Mathema ree (1 major) Computat ree (1 major) Functiona hing degree Gymnasiu ry course MINT Teache ree (1 major) Chemistry ree (1 major) Computat ree (1 major) Mathema	/ (2016) tics (2016) tional Mathematics (201 Il Materials (2016) Im MINT Teacher Educat er Education PLUS, Elite / (2018) tional Mathematics (201	6) ion PLUS, Elite Netwo Network Bavaria (ENI 9)	3) (2016)	

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Biofabrication (2025) Master's degree (1 major) Functional Materials (2025)

Module	Nodule title				Abbreviation		
Physic	al Chen	nistry (Advanced Lab)			08-PCM6-161-m01		
Module	e coord	inator		Module offered by			
lecture	rs Phys	ikalische Chemie (Phy	sical Chemistry)	Institute of Physica	l and Theoretical Ch	emistry	
ECTS	1	od of grading	Only after succ. con	•		,	
5	1	successfully completed					
Duratio		Module level	Other prerequisites				
				1			
1 seme		graduate					
Conten							
This module gives students the opportunity to get involved in the work of one of the research groups based at the Institute of Physical Chemistry and learn some advanced synthesis and analytical methods.							
Intend	ed learı	ning outcomes					
		e become proficient in t ey are able to analyse					
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ge	rman)			
P (4) Module	e taugh	t in: German or English					
		s <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether	
		approx. 20 minutes) ssessment: German ar	d/or English				
	ion of p						
Additio	nal inf	ormation					
		ormation on module du		h course with approx	20 working days		
Worklo							
	au						
150 h							
Teachi	ng cycl	8					
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	immes)			
Module	e appea	irs in					
Master	's degr	ee (1 major) Chemistry	(2016)				
	-	ee (1 major) Mathemat					
		ee (1 major) Computati					
		ning degree Gymnasiur				016)	
		y course MINT Teacher		Network Bavaria (EN	B) (2016)		
		ee (1 major) Chemistry ee (1 major) Computati		a)			
	-	ee (1 major) Computati		9)			
	-	ning degree Gymnasiur	-	ion PLUS. Elite Netwo	ork Bavaria (ENB) (20	020)	
		y course MINT Teacher				/	
		ee (1 major) Computati					
	-	ee (1 major) Mathemat					
Master	's degr	ee (1 major) Chemistry	(2024)				
Master	's degr	ee (1 major) Computati	onal Mathematics (202	24)			
Master's w (2019)	ith 1 majoı	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 163 / 349	



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

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

Module	title				Abbreviation	
Basics	and Ap	plications of Quantum C	hemistry		08-TCM2-161-m01	
Module	e coord	inator		Module offered by		
		ture "Computational Che	mistry"		l and Theoretical Ch	emistry
ECTS		od of grading	Only after succ. com	· · · · ·		
5		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		3.000000	<u> </u>			
		ntroduces students to the	e fundamental princir	les of computationa	ll chemistry.	
		ning outcomes			a chemistry.	
		able to explain the theore	etical principles of co	moutational chemist	ry and to apply met	nods in com-
putatio					ily and to apply meti	
		number of weekly contact hours,	- language — if other than Ger	man)		
S (2) +						
		sessment (type, scope, langua	age — if other than German, e	examination offered — if no	t every semester, informat	ion on whether
		le for bonus)				
		mination (approx. 90 to 1		,		
		ation of one candidate e ation in groups of up to g			didata) ar	
		. 20 pages) or	3 canuluates (applox.	15 minutes per cano	liuale) of	
		n (approx. 30 minutes)				
		ssessment: German and	/or English			
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachir	ıg cycl	e				
Referre	d to in	LPOI (examination regulation	is for teaching-degree progra	mmes)		
Module	appea	ars in				
		ee (1 major) Chemistry (2	2016)			
	-	ee (1 major) Mathematics				
	-	ee (1 major) Computatior		6)		
	-	ee (1 major) Functional N				
		ning degree Gymnasium				016)
		y course MINT Teacher E		Network Bavaria (EN	B) (2016)	
	-	ee (1 major) Chemistry (2				
	-	ee (1 major) Computatior		9)		
	-	ee (1 major) Mathematics	-		and Deverte (END) (	)
		ning degree Gymnasium				020)
		y course MINT Teacher E ee (1 major) Computatior			D) (2020)	
ואומסנכו	JUCSI			21		
		r Computational Mathematics		2)		

Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Modul	e title				Abbreviation	
Numer	ical Me	thods and Programming	£		08-TCM3-161-m01	
Modul	e coord	inator		Module offered by		
		ture "Programmieren in "	Theoretischer Che-			
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s)		
5		rical grade		· · ·		
Duratio		Module level	Other prerequisites	5		
1 seme	ster	graduate				
Conten		Sidduite				
This m	odule p	provides an introduction ation areas.	to the fundamentals	of programming in th	eoretical chemistry	and discus-
Intend	ed lear	ning outcomes				
		able to explain and use on ame its application area	• =	ng languages typical	ly used in theoretica	al chemistry
Course	<b>S</b> (type, r	number of weekly contact hours,	, language — if other than Ge	erman)		
S (2) +	Ü (2)					
Metho	d of ass	sessment (type, scope, langu	lage — if other than German,	, examination offered — if nc	it every semester, informa	ition on whether
		ole for bonus)				
	age of a t <b>ion of</b> [	issessment: German and places	1/or English			
 A al al : 6 : a		ormation				
Additic	onat ini	ormation				
Worklo	ad					
150 h						
-	ng cycl	e				
	3-9-5					
Referre	d to in	LPOI (examination regulation	ns for teaching degree progr	ammes)		
				unin(5)		
Madul		arc in				
	e appea		2016)			
	-	ee (1 major) Chemistry (: ee (1 major) Mathematic				
	-	ee (1 major) Mathematic ee (1 major) Computatio		16)		
	-	ee (1 major) Functional N				
	-	hing degree Gymnasium		tion PLUS, Elite Netw	ork Bavaria (ENB) (:	2016)
		ry course MINT Teacher I				-/
		ee (1 major) Chemistry (2		``		
	-	ee (1 major) Computatio		19)		
	-	ee (1 major) Mathematic				
	-	hing degree Gymnasium	-	tion PLUS, Elite Netwo	ork Bavaria (ENB) (2	2020)
Aaster's w	ith 1 majo	r Computational Mathematics	JMU Würzburg • s	generated 19-Apr-2025 • exam	. reg. data re-	page 167 / 34

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Modul	Module title Abbreviation						
Quanti	um Dyn	amics			08-TCM4-161-m01		
Modul	e coord	inator		Module offered by			
lecture	er of lec	ture "Quantendynamik'	u	Institute of Physica	l and Theoretical Ch	emistry	
ECTS	1	od of grading	Only after succ. con	· · · ·		,	
5		rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conter		Sidduite					
Time-d	Time-dependent Schrödinger equation, propagators, time-dependent perturbation theory, adiabatic theorem, diabatic and adiabatic states, non-adiabatic dynamics, mixed quantum-classical dynamics.						
		ning outcomes					
The stu in mole	udents ecules.	possess knowledge ab Their insight into the m theoretical chemistry.					
Course	<b>es</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)			
S (2) +	Ü (2)						
		s <b>essment</b> (type, scope, lang ole for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether	
Langua		n (approx. 30 minutes) ssessment: German an <b>places</b>					
Additic	nal inf	ormation	_				
Auunt		ormation					
Worklo	had						
150 h							
	ng cycl	0					
Teacin	ing cycu	c					
Deferre	d to in						
Referre		LPO I (examination regulati	ons for teaching-degree progra	ammes)			
Modul	e appea	are in					
		ee (1 major) Chemistry	(2016)				
	-	ee (1 major) Chennstry ee (1 major) Mathemati					
	-	ee (1 major) Computati		6)			
		ee (1 major) Functional		- /			
	-	hing degree Gymnasiur		ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)	
		ry course MINT Teacher		Network Bavaria (EN	B) (2016)		
	-	ee (1 major) Chemistry					
	-	ee (1 major) Computati		9)			
	-	ee (1 major) Mathemati	-				
waster	s teac	hing degree Gymnasiur	n MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	020)	
Master's w (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 169 / 349	

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Module title					Abbreviation		
Selected Topics in Theoretical Chemistry 08-TCM1-161-m01							
Module	e coord	inator		Module offered by			
lecturer of lecture "Theoretische Chemi			mie"	Institute of Physica	l and Theoretical Ch	emistry	
ECTS				,			
5		rical grade		<u> </u>			
Duratio		Module level	Other prerequisites				
1 seme	ester	graduate					
Conten		0					
		ntroduces students to t	he fundamental princi	oles of theoretical ch	emistry.		
		ning outcomes	<u></u>				
			thematical and physical	al principles underly	ing the quantum che	mical and	
		amical approaches of t					
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	man)			
S (2) +	Ü (2)						
Metho	d of ass	sessment (type, scope, lang	uage — if other than German,	examination offered — if no	ot every semester, informati	ion on whether	
		le for bonus)					
		mination (approx. 90 to					
			each (20 to 30 minute		didata) ar		
		. 20 pages) or	o 3 candidates (approx	. 15 minutes per can	didate) or		
		n (approx. 30 minutes)					
		ssessment: German ar					
Allocat	tion of p	olaces					
Additio	onal inf	ormation					
Worklo	ad						
150 h							
Teachi	ng cycl	e					
Referre	ed to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)			
Module appears in							
Master's degree (1 major) Chemistry (2016)							
Master's degree (1 major) Mathematics (2016)							
Master's degree (1 major) Computational Mathematics (2016)							
Master's degree (1 major) Functional Materials (2016)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Master's degree (1 major) Chemistry (2018)							
Master's degree (1 major) Computational Mathematics (2019)							
Master's degree (1 major) Mathematics (2019) Master's teaching degree (1 major) Mathematics (2019)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)							
Master's degree (1 major) Computational Mathematics (2022)							
Master's w (2019)	rith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 171 / 349	

Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Functional Materials (2025)

Module	e title				Abbreviation	
Theore	tical Cł	emistry - Project course	e quantum chemistry		08-TCAP1-161-m01	
Module coordinator				Module offered by	<u> </u>	
head o	f the re	search group offering th	e module		l and Theoretical Ch	emistry
ECTS	1	od of grading	Only after succ. com	· · · ·		ennouy
5	<u> </u>	successfully completed				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
the Ins	titute o	ives students the oppor f Theoretical Chemistry a ntum chemistry.				
Intend	ed lear	ning outcomes				
Studen	ts have	e learned some of the mo	ethods typically used i	in theoretical chemis	stry and, in particula	ar. in quan-
		. They are able to explai				, -1
		umber of weekly contact hours,	_	· · · ·	·	
P (5)		, , ,	- •			
-	d of ace	<b>essment</b> (type, scope, langu	ago — if other than Corman	vamination offered if a	t ovon comostor informat	ion on whathar
		le for bonus)	45e — II other than Gernian, 6	-zammation onered — if no	a every semester, informat	ion on whether
		approx. 30 minutes)				
		ssessment: German and	l/or English			
Allocat	_					
	nalinf	ormation				
		ormation on module dur	ation: block taught lar	o course with approx	. 20 working days.	
Worklo	ad		_			
150 h						
Teachi	ng cycl	9				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)		
Module	annea	rs in				
			2016)			
Master's degree (1 major) Chemistry (2016) Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Computational Mathematics (2016)						
Master's degree (1 major) computational mathematics (2010) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
Master's degree (1 major) Chemistry (2018)						
Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
Master's degree (1 major) Computational Mathematics (2022)						
Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Chemistry (2024)						
	s aegr	ee (1 major) Chemistry (2	2024)			
	- 			4)		
Master		ee (1 major) Computatio		4)		



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

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

Modul	e title			Abbreviation			
Theoretical Chemistry - Project course quantum dynamics         08-TCAP2-161-m01							
Module coordinator				Module offered by			
head o	f the re	search group offering the	e module	Institute of Physica	l and Theoretical Ch	emistry	
ECTS	Metho	od of grading	Only after succ. con	•			
	1	successfully completed					
5 Duratio		Module level	Other preveruisites				
			Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
the Ins	titute o	ives students the opport f Theoretical Chemistry a ntum dynamics.					
Intend	ed learı	ning outcomes					
		e learned some of the me	thods typically used	in theoretical chemi	stry and, in particula	r. in quan-	
		. They are able to explain				,	
		umber of weekly contact hours,		•			
P (5)							
-	d of acc	<b>Sessment</b> (type, scope, langua	age — if other than Corman	examination offered if a	t evenu comoctor informat	ion on whether	
		le for bonus)			a every semester, initial	ion on whether	
		approx. 30 minutes)					
		ssessment: German and	/or English				
	ion of p		<u> </u>				
	· · · ·						
Additio	onal info	ormation					
		ormation on module dura	ation: block taught la	b course with approx	. 20 working days.		
Worklo				<u> </u>			
150 h							
	ng cycl	0					
reacin	ing cycl	6					
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	ammes)			
	e appea						
	-	ee (1 major) Chemistry (2					
Master's degree (1 major) Mathematics (2016)							
Master's degree (1 major) Computational Mathematics (2016)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Chemistry (2018)							
Master's degree (1 major) Computational Mathematics (2019)							
Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)							
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)							
Master's degree (1 major) Computational Mathematics (2022)							
Master's degree (1 major) Mathematics (2022)							
	-	ee (1 major) Chemistry (2	•				
Master	's degr	ee (1 major) Computation	nal Mathematics (202	24)			
Aactor's w	ith 1 majoı	Computational Mathematics	JMU Würzburg ● g	enerated 19-Apr-2025 • exam	. reg. data re-	page 175 / 34	
laster s w				ECTS) Computational Mather			



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

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



# Application Subject Computer Science and Aerospace Computer Science

(ECTS credits)

Module	e title				Abbreviation	
Semina	ır 1 - Cı	irrent Topics in Compute	r Science		10-I=SEM3-161-m01	
Module coordinator				Module offered by		
Dean o	f Studi	es Informatik (Computer	Science)	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
5		rical grade				
Duratio		Module level	Other prerequisites			
1 seme		graduate				
Conten		Sidduite	l			
Indepe	ndentı	review of a current topic i nd oral presentation.	n computer science b	oased on literature a	nd, where applicable, software	
Intende	ed lear	ning outcomes				
The stu	dents	are able to independently	y review a current top	ic in computer scien	ce, to summarise the main	
aspects	s in wri	tten form and to orally pr	esent these in an app	propriate way.		
Course	<b>S</b> (type, r	number of weekly contact hours,	anguage — if other than Ger	man)		
S (2)						
		<b>Sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether	
field of	compu	o to 15 pages) and preser iter science ssessment: German and		ites) with subseque	nt discussion on a topic from th	
Allocat	ion of <b>j</b>	olaces				
Additio	nal inf	ormation				
		able for students of the N LR, HCI´, GE.	laster's programme li	nformatik (Compute	r Science, 120 ECTS credits): AT	
Worklo			-			
150 h						
Teachi	ng cycl	۵	-			
		-				
Roforro	d to in	LPO I (examination regulation	s for toaching dogree are	mmos)		
Referre		LEVE (examination regulation	s for teaching-degree progra	iiiiies)		
Module	appea	urs in				
		ee (1 major) Computer Sc	ience (2016)			
	-	ee (1 major) Mathematics				
		ee (1 major) Computatior		6)		
Master	's degr	ee (1 major) Digital Huma	anities (2016)			
Master's degree (1 major) Computer Science (2017)						
Master's degree (1 major) Computer Science (2018)						
		ee (1 major) Computatior		9)		
	-	ee (1 major) Mathematics				
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
Master	s teaci	ning degree Gymnasium	-	ion PLUS, Elite Netw	ork Bavaria (ENB) (2020)	

Advanced Programming IncleAPR:161:mo1  Module coordinator Module Coordinator Module Computer Science II  Institute of Computer Science II  Institute of Computer Science  CTS Method of grading Only after succ. compL of module(s) I numerical grade -  Duration Module level Other prerequisites I semester graduate -  Contents  With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code a dupicates occur. In this lecture, further knowledge is to be convey of now to give programs and code dupications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, par- allel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing. Courses (pre, number of wretky contact hours, language – if other than German) V(2) + 0 (2) Method of assessment (prep, scope, language – if other than German) V(2) + 0 (2) Method of assessment (prep, scope, language – if other than German) V(2) + 0 (2) Method of assessment (prep, scope, language – if other than German) V(2) + 0 (2) Method of assessment (scope, language – if other than German) V(2) + 0 (2) Method of assessment (scope, language – if other than German) V(2) + 0 (2) Method of assessment (scope, language – if other than German) V(2) + 0 (2) Method of assessment (scope, language – if other than German) V	Module title					Abbreviation		
holder of the Chair of Computer Science II       Institute of Computer Science         ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade          Duration       Module level       Other prerequisites         1           Contents         With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code as aensible structure. Also, further topics in the areas of software security and parallel programming are discussed.         Intendel learning outcomes       Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.         COUTSES (type, number of weekly contact hours, language – if other than Geman)       V (2) (2)         Method of assessment (type, scope, language – if other than Geman)       V (2) (2)         Method of assessment (type, scope, language – if other than Geman)       V (2) (2)         Method of assessment (type, scope, language – if other than Geman)       V (2) (2)         Method of assessment (type, scope, lan	Advanced Programming					10-I=APR-161-m01		
ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade	Module coordinator				Module offered by			
5       numerical grade          Duration       Module level       Other prerequisites         1 semester       graduate          Contents           With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code as sensible structure. Also, further topics in the areas of software security and parallel programming are discussed.         Intended learning outcomes          Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing.         Courses (type, number of weekly contact hours, language – if other than German)       V (2) + 0 (2)         Wethod of assessment (upo, scope, language – if other than German)       V (2) + 0 (2)         Wethod of assessment (upor, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)         witten examination (approx. 6o to 120 minutes), if anounced by the lecturer at the beginning of the course, the written examination in groups of 2 candidates (approx. 15 minutes per candidate).         Language of assessment: German and/or English creditable for bonus          A	holder of the Chair of Computer Scienc		nce II	Institute of Comput	er Science			
Duration         Module level         Other prerequisites           1 semester         graduate            Contents             With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and co-de a sensible structure. Also, further topics in the areas of software security and parallel programming aradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.           Courses (type, number of weekly contact hours, language – if other than German)         V (2) + Ú (2)           Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether medule is creditable for bonuo           written examination (approx. 60 to 120 minutes).         If anounced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).           Language of assessment: German and/or English creditable for bonus	ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
1 semester       graduate          Contents          With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code a sensible structure. Also, further topics in the areas of software security and parallel programming are discussed.         Intended learning outcomes          Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.         Courses (type, number of weekly contact hours, language – if other than German)          V(2) + Ü (2)       Wethod 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. 6 to to 20 minutes).       If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination on one candidate.         Additional information       Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, LR, HCI, ES, GE         Workload          150 h          Teaching c	5	nume	rical grade					
Contents         With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code asensible structure. Also, further topics in the areas of software security and parallel programming are discussed.         Intended learning outcomes       Intended learning outcomes         Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing, concepts are introduced culminating in the use of GPU architectures for extremely quick processing.         Ourses (type, number of weekly contact hours, language – if other than German)       V (2) + 0 (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. 6o to 120 minutes). If anonunced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).         Language of assessment. (Serman and/or English creditable for bonus         Aldictional Information         Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, IL, HCI, ES, GE         Workload <td>Duratio</td> <td>n</td> <td>Module level</td> <td>Other prerequisites</td> <td></td> <td></td> <td></td>	Duratio	n	Module level	Other prerequisites				
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Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IS,LR, HCI, ES,GE           Workload           150 h           Teaching cycle              Referred to in LPO I (examination regulations for teaching-degree programmes)              Module appears in           Master's degree (1 major) Computer Science (2016)           Master's degree (1 major) Computer Science (2016)           Master's degree (1 major) Computer Science (2017)           Master's degree (1 major) Computer Science (2017)           Master's degree (1 major) Computer Science (2018)           Master's degree (1 major) Computer Science (2018)           Master's degree (1 major) Computer Science (2018)           Master's degree (1 major) Computational Mathematics (2019)	Allocat	ion of p	olaces					
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IS,LR, HCI, ES,GE           Workload           150 h           Teaching cycle              Referred to in LPO I (examination regulations for teaching-degree programmes)              Module appears in           Master's degree (1 major) Computer Science (2016)           Master's degree (1 major) Computer Science (2016)           Master's degree (1 major) Computer Science (2017)           Master's degree (1 major) Computer Science (2018)           Master's degree (1 major) Computer Science (2019)								
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Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computer Science (2016)         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's degree (1 major) Computer Science (2017)         Master's degree (1 major) Computer Science (2018)         Master's degree (1 major) Computational Mathematics (2019)         Waster's with 1 major Computational Mathematics         MUWürzburg • generated 19-Apr-2025 • exam. reg. data re-         page 179 / 349	Worklo	ad						
Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computer Science (2016)         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's degree (1 major) Computer Science (2017)         Master's degree (1 major) Computer Science (2018)         Master's degree (1 major) Computer Science (2018)         Master's degree (1 major) Computational Mathematics (2019)         Waster's with 1 major Computational Mathematics         JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 179 / 349	150 h							
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Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 179 / 349	-							
Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 179 / 349	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-								
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	Master's wi (2019)	th 1 majo	Computational Mathematics			-	page 179 / 349	

Master's degree (1 major) Mathematics (2019)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020)

Module title				Abbreviation	
Advanced Automation 10-I=AA-152-m01					
Module	e coord	inator		Module offered by	
holder	of the (	Chair of Computer Science	e VII	Institute of Compute	er Science
ECTS	Metho	od of grading	Only after succ. com	ıpl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
		ics in automation system nsor data processing, act			engineering, for example from d trajectory planning.
Intende	ed learı	ning outcomes			
		nave an advanced knowle d automation systems.	edge of selected topi	cs in automation sys	tems. They are able to imple-
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) +	Ü (2)				
		s <b>essment</b> (type, scope, langua <sub>)</sub> le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
written credita		nation (approx. 60 to 120 bonus	minutes)		
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Focuse: IT,IS,ES			laster's programme li	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
240 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	for teaching-degree progra	mmes)	
§ 22					
Module	appea	irs in			
		ee (1 major) Space Scienc	e and Technology (2	015)	
		mination for the teaching			015)
		ee (1 major) Computer Sc			
	-	ee (1 major) Mathematics			
		ee (1 major) Computation			
		ning degree Gymnasium I			
		y course MINT Teacher Ec ee (1 major) Computer Sc		velwork Bavaria (ENE	5) (2016)
	-	ee (1 major) Computer Sc ee (1 major) Computer Sc			
		es (Master) Computer Sci			
		ee (1 major) Computation	-	9)	
	-	ee (1 major) Mathematics		~	
Master	's teach	ning degree Gymnasium I y course MINT Teacher Ec	MINT Teacher Educati		
Maataria	41	Computational Mathematics	INALL MARTINE A ST	enerated 10-Apr-2025 • exam	reg data re nage 181 / 2/0

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 181 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	

Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module	e title				Abbreviation	
Algorit	hms fo	r Geographic Informatio	on Systems		10-l=AGIS-161-m01	
Module	e coord	inator		Module offered by		
holder	of the (	Chair of Computer Scien	ice l	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
5	nume	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	graduate				
Conten		Sidduite				
Algorith sition, misatio	nmic fo procest	undations of geographi sing, analysis and prese lications such as the cr as well as cartographic g	entation of spatial info eation of digital height	rmation. Processes of	of discrete and conti	nuous opti-
Intende	ed lear	ning outcomes				
The stu	dents	are able to formalise alg improve suitable approa			ic information syste	ms as well as
		number of weekly contact hours		•		
V (2) +		,				
Method	d of ass	<b>Sessment</b> (type, scope, langu le for bonus)	uage — if other than German, e	examination offered — if no	ot every semester, informat	ion on whether
examin prox. 1	ation o 5 minut 1ge of a	by the lecturer at the be of one candidate each (a tes per candidate). ssessment: German and bonus	approx. 20 minutes) or			
Allocat	ion of <sub>l</sub>	olaces				
Additio	nal inf	ormation				
Focuse AT,IS,H		able for students of the	Master's programme li	nformatik (Computer	r Science, 120 ECTS (	credits):
Worklo	ad					
150 h						
Teachi	ng cvcl	e				
	0 - )					
Referre	d to in	LPO I (examination regulation	ins for teaching-degree progra	mmes)		
	<u></u>					
Module	annes	ars in				
			cience (2016)			
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016)						
Master's degree (1 major) Mathematics (2010) Master's degree (1 major) Computational Mathematics (2016)						
	-	hing degree Gymnasium			ork Bavaria (ENB) (20	016)
		ry course MINT Teacher		Network Bavaria (EN	B) (2016)	
	Master's degree (1 major) Computer Science (2017)					
	Master's degree (1 major) Computer Science (2018)					
		ee (1 major) Computatio		9)		
		ee (1 major) Mathematic		enerated 19-Apr-2025 • exam	reg data re-	page 183 / 349
(2019)	ini i ilidj0			ECTS) Computational Mather	-	page 103 / 349

Master's degree (1 major) Information Systems (2019)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020)

Module title Abbreviation						
Computational Geometry 10-I=AG-161-m01						
Module	e coord	inator		Module offered by		
holder	of the (	Chair of Computer Scie	nce l	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
formati algorith	on syst nmic as	ems it is necessary t pects of these tasks: V	for example robotics, o o store, analyse, create /e will acquire techniqu echnique will be illustr	or manipulate spati ues that are needed t	al data. This class is to plan and analyse	about the geometric al-
Intende	ed learı	ning outcomes				
metric	probler	n. The students are abl	h algorithms or data st e to analyse new probl es acquired in the lectu	ems and to come up		
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Gei	rman)		
V (2) +	Ü (2)					
		e <b>ssment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
lf anno examin prox. 1 <u>9</u> Langua	unced ation o 5 minut ge of a	f one candidate each ( es per candidate). ssessment: German ar	eginning of the course, approx. 20 minutes) or			
credita						
Allocat	ion of p	olaces				
		ormation				
Focuse AT,HCI,		able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS (	credits):
Worklo	ad					
150 h						
Teachi	ıg cycl	e				
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)		
Module	e appea	rs in				
Module appears in         Master's degree (1 major) Computer Science (2016)         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)         Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)         Master's degree (1 major) Computer Science (2017)         Master's degree (1 major) Computer Science (2018)         Master's with 1 major Computational Mathematics						
(2019)				ECTS) Computational Mathen	-	

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Aerospace Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Aerospace Computer Science (2023)

Module title Ab				Abbreviation		
Approximation Algorithms 10-I=APA-161-m01						
Module	e coord	inator		Module offered by		
holder	of the (	Chair of Computer Scier	nce l	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
there a are use drafting practica	re man d whic g and a al optir	ding the optimal soluti y problems without an h do not always give th nalysing techniques fo nisation problems, the search, scaling as well a	efficient algorithm for a e optimal solution but r algorithms which hav lecture will introduce s	an optimal solution. always give good so e a proven approxim tudents to importan	As a result, in practi- lutions. This lecture ation quality. With t	ce, methods will discuss he help of
Intende	ed lear	ning outcomes				
damen gramm	tal draf ing and	are able to analyse eas ting techniques such a d are able to apply thes	s greedy, local search a e to new problems.	and scaling as well a		
		number of weekly contact hours	s, language — if other than Gei	man)		
V (2) +						
		<b>Sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
lf anno examin prox. 1	unced ation c 5 minut ge of a	nation (approx. 60 to 12 by the lecturer at the be of one candidate each ( tes per candidate). ssessment: German an bonus	eginning of the course, approx. 20 minutes) or			
Allocat	ion of <sub>l</sub>	olaces				
Additio	nal inf	ormation				
Focuse AT,IT,G		able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS o	credits):
Worklo	ad					
150 h						
Teachir	ng cycl	e				
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
§ 22 II Nr. 3 b)						
Module appears in						
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017)						
Master's wi (2019)	п 1 тајо	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 187 / 349

Master's degree (1 major) Computer Science (2018) Module studies (Master) Computer Science (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computer Science (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Computer Science (2025) Master's degree (1 major) Mathematical Data Science (2025)

UNIVERSITÄT

WÜRZBURG

Module title				Abbreviation		
Automa	Automata Theory 10-I=AUT-161-m01					
Module	e coordi	inator		Module offered by		
Dean o	f Studie	es Informatik (Compute	r Science)	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	· · · · ·	rical grade		•		
Duratio	<u> </u>	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts	-	-			
words,	langua	a, regular languages, s ge acceptance through anguages and star-free	monoids, syntactic mo	onoid, predicate logi		
Intend	ed learr	ning outcomes				
ges, sta	ar-free l ds, synt	oossess a fundamental anguages, natural equi actic monoid, predicate nata.	valence relations, pred	dicate logic with wor	ds, language accept	ance through
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	rman)		
V (2) +	Ü (2)					
module is	s creditab	essment (type, scope, langu le for bonus) nation (approx. 60 to 12		examination offered — if no	t every semester, informati	on on whether
lf anno examir prox. 1	unced l ation o 5 minut ge of a	by the lecturer at the be f one candidate each (a es per candidate). ssessment: German an	ginning of the course, approx. 20 minutes) or			
Allocat	ion of p	olaces				
Additio	onal info	ormation				
Focuse IT, ES,		able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS o	redits): AT,
Worklo	ad					
150 h						
Teachi	ng cycle	e				
Referre	d to in	LPOI (examination regulation	ns for teaching-degree progra	mmes)		
Module	e appea	rs in				
Master	's degre	ee (1 major) Computer S	cience (2016)			
Master's degree (1 major) Mathematics (2016)						
	-	ee (1 major) Computatio				
		ning degree Gymnasium				o16)
		y course MINT Teacher		Network Bavaria (ENI	B) (2016)	
	-	ee (1 major) Computer S				
		ee (1 major) Computer S		<b>`</b>		
	-	ee (1 major) Computatio		9) enerated 19-Apr-2025 • exam	reg data re	nage 190 / 2/ C
(2019)	iai i major			ECTS) Computational Mathen		page 189 / 349



Master's degree (1 major) Mathematics (2019)

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

Module title Abbreviation				Abbreviation	
Avionics Systems 10-I=AVS-161-m01					10-I=AVS-161-m01
Module	e coord	inator		Module offered by	
holder	of the (	Chair of Computer Scienc	e VIII	Institute of Compute	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
commu	nicatio		tes: 1. software mod	ule and the software	ardware, sensors, actuators and structure 2. control 3. ground
Intende	ed lear	ning outcomes			
		he course, the students s . They should be able to c			of avionic systems for satellites ram simple controls.
Course	<b>S</b> (type, r	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) +	Ü (2)				
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
lf annoi examin prox. 15	unced ation c 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Focuses ES,LR	s availa	able for students of the M	laster's programme li	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	e appea	ars in			
Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)					

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 191 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computer Science (2023) Master's degree (1 major) Computational Mathematics (2024)

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

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

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

Master's degree (1 major) Computer Science (2025)

Module title				Abbreviation		
Multim	Multimodal User Interfaces 10-HCI=MMUI-161-mo1					
Module	e coord	inator		Module offered by		
holder	of the (	Chair of Computer Scienc	e IX	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
The multimodal interaction paradigm simultaneously uses various modalities like speech, gesture, touch, or ga- ze, to communicate with computers and machines. Basically, multimodal interaction includes the analysis as well as the synthesis of multimodal utterances. This course concentrates on the analysis, i.e., the input proces- sing. Input processing has the goal to derive meaning from signal to provide a computerized description and un- derstanding of the input and to execute the desired interaction. In multimodal systems, this process is interlea- ved between various modalities and multiple interdependencies exist between simultaneous utterances neces- sary to take into account for a successful machine interpretation. In this course, students will learn about the necessary steps involved in processing unimodal as well as multimo- dal input. The course will highlight typical stages in multimodal processing. Using speech processing as a prima- ry example, they learn about: 1. A/D conversion 2. Segmentation 3. Syntactical analysis 4. Semantic analysis 5. Pragmatic analysis 6. Discourse analysis A specific emphasize will be on stages like morphology and semantic analysis. Typical aspects of multimodal in- terdependencies, i.e., temporal and semantic interrelations are highlighted and consequences for an algorithmic processing are derived. Prominent multimodal integration (aka multimodal fusion) approaches are described, in-						
		ning outcomes				
standir	ng of al		olved and will know p	prominent algorithmi	ces. They will have a broad under- ic solutions for each of them. Stu- is.	
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Gei	rman)		
V (2) +	Ü (2)					
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	t every semester, information on whether	
•	ge of a	of project results (approx ssessment: German and, bonus				
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Focuse HCI,GE		able for students of the N	laster's programme l	nformatik (Computer	Science, 120 ECTS credits):	
Worklo	ad					
150 h						

# Teaching cycle

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

§ 22 II Nr. 3 b)
Module appears in
Master's degree (1 major) Computer Science (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Computer Science (2017)
Master's degree (1 major) Computer Science (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Aerospace Computer Science (2020)
Master's degree (1 major) Computer Science (2021)
Master's degree (1 major) Aerospace Computer Science (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Computer Science (2023)
Master's degree (1 major) Aerospace Computer Science (2023)
Master's degree (1 major) Computational Mathematics (2024)
Master's degree (1 major) Mathematics (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Master's degree (1 major) Computer Science (2025)

(2019)

Module title					Abbreviation		
Computability Theory 10-I=BER-161-m01							
Module	e coord	inator		Module offered by			
Dean o	f Studie	es Informatik (Compute	er Science)	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
			ons, decidable and cou ability, Turing reduction				
Intende	ed learr	ning outcomes					
ons, de	cidable	e and countable sets, h	l and applicable knowle halting problem, m-redu degrees, arithmetic hie	icibility, creative and			
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ger	man)			
V (2) +	Ü (2)						
Method	l of ass	essment (type, scope, lang	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether	
		le for bonus) nation (approx. 60 to 1:					
examin prox. 15	ation o 5 minut ge of a	f one candidate each ( es per candidate). ssessment: German ar	eginning of the course, approx. 20 minutes) or nd/or English				
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Focuse: AT,SE,I		able for students of the	Master's programme l	nformatik (Computer	Science, 120 ECTS o	redits):	
Worklo	ad						
150 h							
Teachir	ıg cycl	e					
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)			
Module	e appea	irs in					
Master	's degre	ee (1 major) Computer :	Science (2016)				
	-	ee (1 major) Mathemati					
	-		onal Mathematics (201		aule Daviania (END) (a.		
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
		ee (1 major) Computer :			D) (2010)		
	-	ee (1 major) Computer :					
	-		onal Mathematics (201	9)			
Master	's degre	ee (1 major) Mathemati	cs (2019)				
Master's wi	th 1 major	Computational Mathematics	JMU Würzburg ● g	enerated 19-Apr-2025 • exam	. reg. data re-	page 195 / 349	
(2019)			cord Master (120	ECTS) Computational Mather	natics - 2019		



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

Module title				Abbreviation			
Bioinformatics 07-BI-161-m01							
Modul	e coord	inator		Module offered by			
holder	of the (	Chair of Bioinformatics		Faculty of Biology			
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5		rical grade		-			
Durati		Module level	Other prerequisites				
1 seme	_	undergraduate					
Conter		undergraduate					
		nvinciples of hisinform	ation				
		principles of bioinform					
		ning outcomes					
			or the analysis of DNA a	•	es.		
Course	<b>es</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)			
V (2) +	Ü (2)						
Metho	d of ass	<b>sessment</b> (type, scope, lang	guage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether	
		le for bonus)					
		nation (approx. 60 to 1					
			eginning of the course,				
		es per candidate).	approx. 20 minutes) or		i ili gloups ol 2 callu	iuales (ap-	
		ssessment: German ar	ıd/or English				
	ble for		, 0				
Allocat	tion of p	olaces					
Additio	onal inf	ormation					
Worklo	had						
150 h							
Teachi	ng cycl	e					
Referre	ed to in	LPOI (examination regulati	ons for teaching-degree progra	ammes)			
Modul	e appea	urs in					
Master	r's degr	ee (1 major) Computer	Science (2016)				
	-	ee (1 major) Mathemat					
	-		onal Mathematics (201	6)			
	-	ee (1 major) Computer					
	-	ee (1 major) Computer		`			
	Master's degree (1 major) Computational Mathematics (2019)						
	Master's degree (1 major) Mathematics (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
1			Education PLUS, Elite			020)	
		•	onal Mathematics (202		D) (2020)		
	-	ee (1 major) Computati ee (1 major) Mathemati		- 2)			
	-	-	onal Mathematics (202				
	-	ee (1 major) Mathemati		ידי			
Master's w (2019)	nin 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 197 / 349	



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

Module title					Abbreviation	
Compiler Construction     10-I=CB-161-mo1						
Module coordinator				Module offered by		
holder	ofthe	Chair of Computer Scie	nce II	Institute of Comput	er Science	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio		Module level	Other prerequisites	6		
1 seme	ster	graduate				
Conten		0				
		is, syntactic analysis, s	emantics, compiler ge	nerators, code gener	rators, code optimisa	ation
		ning outcomes				
		possess knowledge in	the formal description	of programming lang	uages and their com	nilation
They ar	re able	to perform transformat generators.				
		number of weekly contact hour	s, language — if other than Ge	rman)		
V (2) +	-	· · · · · · · · · · · · · · · · · · ·				
Metho	d of ass	<b>Sessment</b> (type, scope, lang ole for bonus)	uage — if other than German,	examination offered — if no	ot every semester, informati	ion on whether
examin prox. 1	nation o 5 minut age of a	by the lecturer at the b of one candidate each ( tes per candidate). ssessment: German ar bonus	approx. 20 minutes) or			
Allocat	ion of	places				
Additio	onal inf	ormation				
Focuse SE,IT,IS		able for students of the	Master's programme I	nformatik (Computer	r Science, 120 ECTS o	credits):
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regulati	ons for teaching-degree progra	ammes)		
	<u></u>					
Module	annea	ars in				
		ee (1 major) Computer	Science (2016)			
	-					
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016)						
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
		ee (1 major) Computer				
	Master's degree (1 major) Computer Science (2018)					
	Master's degree (1 major) Computational Mathematics (2019)					
	-	ee (1 major) Mathemat	-			
Master	's degr	ee (1 major) Informatio	n Systems (2019)			
	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam		page 199 / 349
(2019)			cord Master (120	ECTS) Computational Mather	natics - 2019	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Information Systems (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

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

Master's with 1 major Computational Mathematics (2019)

Module title					Abbreviation	
Deducti	ive Dat	abases			10-I=DDB-161-m01	
Module	coord	inator		Module offered by		
Dean of	fStudie	es Informatik (Computer S	Science)	Institute of Compute	er Science	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten	ts					
		mantics of logic program or Datalog; negation and		-	d applications for Prolog; analyti-	
Intende	ed learr	ning outcomes				
The stu	dents p	oossess expertise in work	king with Prolog and I	Datalog (including ne	egation and disjunction).	
Courses	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) + l	Ü (2)					
		e <b>essment</b> (type, scope, langua) le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
lf annou examin prox. 15	unced l ation o 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, pprox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-	
Allocati	ion of p	olaces				
Additio	nal info	ormation				
Focuses AT,SE,I		able for students of the M	laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits):	
Worklo	ad					
240 h						
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination regulations	s for teaching-degree progra	mmes)		
Module appears in						
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						

Module title					Abbreviation
E-Learning 10-I=EL-161-1					10-I=EL-161-m01
Module	coord	inator		Module offered by	
holder	of the O	Chair of Computer Science	e VI	Institute of Comput	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts	0	L		
intellige stems,	ent tuto adaptiv	oring systems, student m ve tutoring systems, com	odels, didactics, prol	blem-oriented learning	standards for learning systems, ng and case-based training sy- aluation of learning systems.
		ning outcomes			
The stu plicatio		oossess a theoretical and	l practical knowledge	e about eLearning an	d are able to assess possible ap-
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) +	Ü (2)				
		e <b>ssment</b> (type, scope, langua) le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
lf annoi examin prox. 15	unced l ation o 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, pprox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocat	ion of p	olaces			
		ormation		<b>f i i i i i i i i i i</b>	
Focuses SE,IT,IS			laster's programme li	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	9			
Referre	d to in	LPOI (examination regulations	s for teaching-degree progra	mmes)	
Module	e appea	irs in			
Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)					

Master's degree (1 major) Media Communication (2019) Master's degree (1 major) Information Systems (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Module title Abbreviation					Abbreviation	
Introduction into Human-Computer Interaction					10-MCS=HCI-161-m01	
Module coordinator				Module offered by		
holder	of the C	hair of Computer Scienc	e IX	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten	ts					
puting s introduce user an existing The cour- ve syste niques, desktop this fiel <b>Intende</b> After the comput learn at	Human-Computer Interaction is concerned with the design, evaluation and implementation of interactive com- puting systems for human use and with the study of major phenomena surrounding them. This course gives an introduction into the principle biological, physiological, and psychological constraints as defined by the human user and relates these constraints to the conceptual and technical solutions of today's computer systems and existing as well as prospective interaction metaphors between humans and computers. The course covers topics about human perception and cognition, memory and attention, the design of interacti- ve systems, prominent evaluation methods, the principles of computer systems, typical input processing tech- niques, interface technology, and examples of typical interaction metaphors, from text-based input to graphical desktops to multimodal interfaces. Accompanying lab-work will introduce students to typical tasks involved in this field, i.e., prominent evaluation methods and prototyping of interfaces. <b>Intended learning outcomes</b> After the course, the students will have a broad understanding of the underlying principles of human users and computer systems. They will understand the constraints and capabilities of current user interfaces and they will learn about the necessary steps applied in user-centered design and development approaches.					
V (2) + Ú		umber of weekly contact hours, l				
module is present	creditab ation c ge of a	<sup>le for bonus)</sup> if project results (approx. ssessment: German and/	. 30 minutes)	examination offered — if no	t every semester, information on whether	
Allocati						
Additio	nal info	ormation				
Workloa	ad					
150 h						
Teachin	ig cycl	9				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Module	appea	rs in				
		ee (1 major) Mathematics				
		ee (1 major) Computation				
		ee (1 major) Computation		9)		
Master's degree (1 major) Mathematics (2019)						

Module title				Abbreviation		
Embedded Systems 10-I=ES-161-m01						
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Informatik (Computer	Science)	Institute of Comput	er Science	
ECTS		od of grading	Only after succ. compl. of module(s)			
8	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
	s, impl	bedded systems, implem ementation planning sta				
Intende	ed lear	ning outcomes				
	nportar	are familiar with the tech nt techniques for the mod				
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) +	Ü (2)					
Metho	d of ass	<b>sessment</b> (type, scope, langua	ige — if other than German, o	examination offered — if no	t every semester, informati	ion on whether
module is	s creditab	le for bonus)				
lf anno examin prox. 1	unced ation c 5 minut ge of a	nation (approx. 60 to 120 by the lecturer at the beg of one candidate each (ap res per candidate). ssessment: German and bonus	inning of the course, oprox. 20 minutes) or			
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Focuse AT,SE,E		able for students of the M E	laster's programme l	nformatik (Computer	Science, 120 ECTS o	credits):
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	urs in				
Master	's degr	ee (1 major) Computer Sc	ience (2016)			
	-	ee (1 major) Mathematics				
Master	's degr	ee (1 major) Computatior	al Mathematics (201	6)		
Master	's teacl	ning degree Gymnasium	MINT Teacher Educat	ion PLUS, Elite Netwo	ork Bavaria (ENB) (20	016)
Supple	mentai	ry course MINT Teacher E	ducation PLUS, Elite I	Network Bavaria (ENI	B) (2016)	
Master	's degr	ee (1 major) Computer Sc	ience (2017)			
	-	ee (1 major) Computer Sc				
	-	ee (1 major) Computatior		9)		
		ee (1 major) Mathematics	-			
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 205 / 349

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Aerospace Computer Science (2022) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Aerospace Computer Science (2023)

Module title				Abbreviation		
Analysis and Design of Programs 10-I=PA-161-m01						
Modul	Module coordinator Modu				<u> </u>	
holder	of the	Chair of Computer Scie	nce II	Institute of Comput	er Science	
ECTS		od of grading	Only after succ. con	· · ·		
5		rical grade				
Durati	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conte	nts					
Progra	m analy	sis, model creation in	software engineering, p	orogram quality, test	of programs, proces	s models.
Intend	ed lear	ning outcomes				
The stu quality		are able to analyse pro	grams, to use testing fr	ameworks and metri	cs as well as to judg	e program
		aumhar afwaakly cantact haur	s, language — if other than Ger	man)		
V (2) +				IIIdii)		
		S <b>essment</b> (type, scope, lang ble for bonus)	guage — if other than German, o	examination offered — if no	t every semester, informati	on on whether
If anno examin prox. 1 Langua credita	ounced nation o 5 minutage of a able for	of one candidate each ( tes per candidate). Issessment: German ar bonus	eginning of the course, approx. 20 minutes) or			
Alloca	tion of	places				
Additi	onal inf	ormation				
Focuse SE,IS,E		able for students of the	Master's programme l	nformatik (Computer	Science, 120 ECTS o	credits):
Workl						
150 h						
	ing cycl	•				
Teacin	ing cyci	e				
Referr	ed to in	LPOI (examination regulati	ons for teaching-degree progra	mmes)		
Modul	e appea	ars in				
Maste	r's degr	ee (1 major) Computer	Science (2016)			
	-	ee (1 major) Mathemat				
	-	ee (1 major) Physics (2				
Master's degree (1 major) Nanostructure Technology (2016)						
	Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
1						U16 <i>)</i>
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
	Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)					
	-		onal Mathematics (201	<b>a</b> )		
	-	ee (1 major) Mathemat		<i>,,</i>		
·						· · · · · · · · · · · · · · · · · · ·
Master's v (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 207 / 349

Master's degree (1 major) Information Systems (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Master's with 1 major Computational Mathematics (2019)

Module title				Abbreviation		
Information Retrieval 10-I=IR-161-m01						
Module coordinator				Module offered by		
Dean o	f Studi	es Informatik (Compute	r Science)	Institute of Comput	er Science	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts		-			
data st ges and thods t	ructure d parac o supp	g. Boolean and vector s s (e. g. inverted index), ligms, structured querie ort IR (e. g. recommend	query elements (e. g. es), search engine (e. g	query operations, rel . architecture, crawli	evance feedback, quing, interfaces, link a	uery langua- analysis), me-
Intende	ed lear	ning outcomes				
		possess theoretical and know-how to create a se		n the area of informa	ation retrieval and ha	ave acquired
Course	<b>S</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
V (2) +	Ü (2)					
		<b>Sessment</b> (type, scope, lang ole for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
prox. 1	5 minut Ige of a	of one candidate each (a tes per candidate). ssessment: German an bonus		an oral examination	in groups of 2 cand	idates (ap-
Allocat	ion of <sub>l</sub>	places				
Additio	nal inf	ormation				
Focuse IT,IS,H(		able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS (	credits):
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ns for teaching-degree progra	immes)		
	-					
Module	e appea	ars in				
Master	's degr	ee (1 major) Computer S	cience (2016)			
	Master's degree (1 major) Mathematics (2016)					
	Master's degree (1 major) Computational Mathematics (2016)					
	-	ee (1 major) Digital Hum				
		hing degree Gymnasiun Ny course MINT Teacher				J10)
	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017)					
	-	ee (1 major) Computer S				
	-	ee (1 major) Computatio		9)		
		r Computational Mathematics	JMU Würzburg • g	enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 209 / 349

Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Module title Abbreviation							
3D User Interfaces					10-HCI=3DUI-161-m	01	
Module	e coord	inator		Module offered by			
holder	of the O	Chair of Computer Scier	nce IX	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
lopment to learn ques. D on, the tegratir practica deo. Pro betwee	This module will give students the opportunity to learn about the specificities of 3D User Interfaces (3DUI) deve- lopment using Virtual, Augmented or Mixed Reality technologies. The module content will be mainly dedicated to learn and practice the skills essential to the design and implementation of high-quality 3D interaction techni- ques. Design guidelines as well as classical and innovative 3D Interaction techniques will be studied. In additi- on, the course will address novel research themes such as 3D interaction for large displays and games; and in- tegrating 3DUIs with mobile devices, robotics, and the environment. Students will be assessed through a group practical project (team work), which will consist of a program, a presentation, a technical report (2 ages) and a vi- deo. Previous years, the assignment replicated the IEEE 3DUI Contest 2011, where teams of students competed between each other to find the best solution (see results at https://www.youtube.com/watch?v=gYs-pBW7Agc						
	<u> </u>	ww.youtube.com/watc	n:v-grs-pbw/Agc)				
spatial spatial put dev	interfa interfa vices (e	se, the students will ga ces. They will have a br ces, as well as evaluati .g, motion tracking sys umber of weekly contact hours	oad understanding of t ng then. Students will tem and Head-mounter	the particular difficul also learn about trac d Display).	lties of designing an	d developing	
V (2) +	Ü (2)						
		s <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German, d	examination offered — if no	t every semester, informati	on on whether	
	ge of a	of project results (appro ssessment: German an bonus					
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Focuse: HCI,GE.		able for students of the	Master's programme l	nformatik (Computer	r Science, 120 ECTS o	credits):	
Worklo	ad						
150 h							
Teachir	ıg cycl	e					
Referre	d to in	LPOI (examination regulation	ons for teaching-degree progra	mmes)			
§ 22	Vr. 3 b)						
Module	e appea	in					
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computer Science (2017)							
Master's wi (2019)	th 1 majoi	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	•	page 211 / 349	

Master's degree (1 major) Computer Science (2018)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

UNIVERSITÄT

WÜRZBURG

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

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

Master's degree (1 major) Computer Science (2021)

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

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

Master's degree (1 major) Computer Science (2023)

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

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

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

Master's degree (1 major) Computer Science (2025)

Module title				Abbreviation		
Computational Complexity II 10-I=KT2-161-m01						
Module coordinator				Module offered by		
Dean o	f Studi	es Informatik (Compute	er Science)	Institute of Comput	er Science	
ECTS	1	od of grading	Only after succ. con	· · ·		
5	1	rical grade				
Duratio		Module level	Other prerequisites			
				•		
1 seme		graduate				
Conten						
		NP-complete sets, auto stic algorithms.	reducibility, interactive	e proof systems, poly	nomial time hierarch	hy, complexi-
Intende	ed lear	ning outcomes				
		possess a fundamenta ty, interactive proof sy				
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (2) +	Ü (2)					
		Sessment (type, scope, lang ole for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
prox. 1	5 minut ige of a	of one candidate each ( tes per candidate). ssessment: German ar bonus		an oral examination	in groups of 2 cand	idates (ap-
Allocat	ion of <sub>l</sub>	places				
Additio	onal inf	ormation				
Focuse SE, IT, I		able for students of the	Master's programme I	nformatik (Computer	r Science, 120 ECTS o	credits): AT,
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Poforro	d to in	LPO I (examination regulati				
Kelelle		LFUI (examination regulation	ons for teaching-degree progra	ammes)		
		•				
Module						
	-	ee (1 major) Computer				
	-	ee (1 major) Mathemat ee (1 major) Computati		6)		
	-	hing degree Gymnasiur			ork Bayaria (FNB) (2)	016)
		ry course MINT Teacher				010)
		ee (1 major) Computer			_, (2010)	
		ee (1 major) Computer				
	-	ee (1 major) Computati		9)		
	-	ee (1 major) Mathemat		-		
	-	hing degree Gymnasiur	-	ion PLUS, Elite Netwo	ork Bavaria (ENB) (2	020)
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 213 / 349
(-019)			coru musici (120	2010) computational mather		



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

Master's with 1 major Computational Mathematics (2019) JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2019

Module title					Abbreviation	
Artificial Intelligence 1					10-l=Kl1-161-m01	
Module coordinator				Module offered by		
holder	ofthe	Chair of Computer Scier	nce VI	Institute of Comput	er Science	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on .	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	ts	0	l			
		ents, uninformed and h and predicate logic and			, search with partial	information,
Intende	ed lear	ning outcomes				
		possess theoretical and gic and are able to asse			gence in the area of	agents,
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (2) +	Ü (2)					
		<b>Sessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
lf anno examin prox. 1	unced nation o 5 minut age of a	nation (approx. 60 to 12 by the lecturer at the be of one candidate each ( tes per candidate). ssessment: German an bonus	eginning of the course, approx. 20 minutes) or			
Allocat	ion of	olaces				
Additio	onal inf	ormation				
	s avail	able for students of the	Master's programme l	nformatik (Computer	Science, 120 ECTS o	credits):
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Module	e annea	ars in				
		ee (1 major) Computer S	Science (2016)			
	-	ee (1 major) Mathemati				
Master	's degr	ee (1 major) Physics (20	016)			
Master	's degr	ee (1 major) Nanostruct	ure Technology (2016)			
	-	ee (1 major) Computatio				
		hing degree Gymnasiun				016)
		ry course MINT Teacher		Network Bavaria (EN	B) (2016)	
	-	ee (1 major) Computer S				
	-	ee (1 major) Computer S		a)		
master	s uegr	ee (1 major) Computatio	Shat Mathematics (201	9)		l
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 215 / 349

Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021)

Module title			Abbreviation		
Artificia	al Intel	ligence 2			10-l=Kl2-161-m01
Module	coord	inator		Module offered by	
holder	of the C	hair of Computer Scienc	e VI	Institute of Comput	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts	-			
observa ning, pr	ations, rocessi	knowledge while learnin ng of natural language.			bility problems, learning from g methods, reinforcement lear-
Intende	ed learn	ning outcomes			
		possess theoretical and p ng and language process	-		gence in the area of probabilistic ications.
Courses	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) + l	Ü (2)				
		e <b>essment</b> (type, scope, langua; le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
lf annou examin prox. 15	unced l ation o 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	ion of p	olaces			
Additio	nal info	ormation			
Focuses AT,SE,IS			laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	9			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	rs in			
Master' Master' Master' Supple Master' Master' Master'	Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)				

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 217 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	

Master's degree (1 major) Information Systems (2019)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020)

Module title				Abbreviation		
Perform	nance I	Evaluation of Distributed	l Systems		10-l=LVS-161-m01	
Module	e coord	inator		Module offered by		
holder	of the (	Chair of Computer Scien	ce III	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
8	nume	rical grade		•		
Duratio		Module level	Other prerequisites			
1 seme	ster	graduate				
Conten		5.444446	1			
Traffic theoretic models, fundamental concepts of theory of probability, transformation techniques, stochastic processes, methods for performance analysis of technical systems, queue-/traffic theory, analysis of Markov, non-Markov and time critical systems, matrix analytical method, practical examples for performance analysis of computer systems and networks: throughput and goodput analysis and other characteristics.						
Intende	ed lear	ning outcomes				
		bossess the methodic kr theory of probability and			y to model technica	l systems by
Course	<b>S</b> (type, r	umber of weekly contact hours,	language — if other than Ger	man)		
V (4) +						
Method	d of ass	s <b>essment</b> (type, scope, langua	age — if other than German, e	examination offered — if no	t every semester, informati	on on whether
prox. 19 Langua credita	5 minut ge of a ble for					luates (ap-
Allocat	ion of p	olaces				
	s availa	ormation able for students of the I	Master's programme li	nformatik (Computer	Science, 120 ECTS (	credits):
Worklo	ad					
240 h						
Teachi	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	mmes)		
Module	e appea	nrs in				
Master	's degr	ee (1 major) Computer S	cience (2016)			
Master	's degr	ee (1 major) Mathematic	s (2016)			
Master's degree (1 major) Computational Mathematics (2016)						
		ning degree Gymnasium				016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)						
	Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)					
	-	ee (1 major) Computer So ee (1 major) Computation		ວ)		
	-	ee (1 major) Mathematic		<del>7</del> /		
		Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 219 / 349



Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Aerospace Computer Science (2022) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Module title			Abbreviation		
Mathen	natical	Logic			10-l=ML-161-m01
Module	coord	nator		Module offered by	
Dean of	fStudie	es Informatik (Computer S	Science)	Institute of Compute	er Science
ECTS	ECTS Method of grading Only after succ. compl. of module(s)				
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Content	ts	-			
		logic, first-order predicat ncompleteness theorem,			npleteness theorem, Tarski theo- of elemental arithmetic.
Intende	ed learr	ing outcomes			
predica	te logi		ödel's completeness	theorem, Tarski the	propositional logic, first-order orem, Gödel's incompleteness
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) + ĺ	Ü (2)				
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	xamination offered — if no	t every semester, information on whether
lf annou examina prox. 15	unced l ation o ; minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	ion of p	laces			
Additio	nal info	ormation			
Focuses AT,SE,IS		ble for students of the M	laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachin	ng cycl	9			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	rs in			
Master' Master' Master' Suppler Master' Master' Master'	Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)				

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 221 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	



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

Module title			Abbreviation		
Medica	l Inforr	natics			10-l=Ml-161-m01
Module	coord	inator		Module offered by	
holder	of the (	Chair of Computer Science	e VI	Institute of Compute	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
mary ar	Electronic patient folder, coding of medical data, hospital information systems, operation of computers in infir- mary and functional units, medical decision making and assistance systems, statistics and data mining in medi- cal research, case-based training systems in medical training.				
Intende	ed leari	ning outcomes			
The stu medicir		possess theoretical and p	oractical knowledge a	bout the application	of computer science methods in
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) + İ	Ü (2)				
			ge — if other than German, e	examination offered — if no	t every semester, information on whether
		le for bonus) nation (approx. 60 to 120			
examin prox. 15	ation o ; minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Focuses SE,IT,IS			laster's programme lr	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	irs in			
Master' Master' Master' Suppler Master' Master' Master'	s degro s degro s teach mentar s degro s degro s degro	ee (1 major) Computer Sc ee (1 major) Mathematics ee (1 major) Computation ning degree Gymnasium <i>I</i> y course MINT Teacher Ec ee (1 major) Computer Sc ee (1 major) Computer Sc ee (1 major) Computation ee (1 major) Mathematics	6 (2016) al Mathematics (2010 MINT Teacher Educati ducation PLUS, Elite M ience (2017) ience (2018) al Mathematics (2019	on PLUS, Elite Netwo Network Bavaria (ENI	

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 223 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	



Master's degree (1 major) Information Systems (2019)

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

Master's with 1 major Computational Mathematics

(2019)

Module title			Abbreviation		
Perform	nance E	ingineering & Benchmarl	king of Computer Sys	stems	10-I=PEB-161-m01
Module	coord	inator		Module offered by	
holder	of the O	Chair of Computer Science	e ll	Institute of Comput	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten		<u> </u>			
					rmance measurement techni- e prediction, case studies.
Intende	ed learn	ning outcomes			
ment te	chniqu		ce analysis, data ana	llysis with R, benchn	performance metrics, measure- nark approaches, modelling with ts.
Courses	<b>S</b> (type, n	umber of weekly contact hours, la	anguage — if other than Ger	man)	
V (2) + l	Ü (2)				
		e <b>ssment</b> (type, scope, languag le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
lf annou examin prox. 15	unced l ation o ; minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	ion of p	olaces			
Additio	nal info	ormation			
Focuses SE,IT,ES			laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	9			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	irs in			
Master' Master' Master' Supple Master' Master' Master'	Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)				

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2019

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Master's degree (1 major) Information Systems (2019)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020)

Module title				Abbreviation	
Comput	ter Arit	hmetic			10-I=RAM-161-m01
Module	coord	inator		Module offered by	
holder	of the (	Chair of Computer Scienc	e ll	Institute of Comput	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
		nerical computation, rast I calculation.	er and rounding, defi	nition and implemer	ntation of computational arithme-
Intende	ed learı	ning outcomes			
			•	•	aster and roundings, definition naster the application of algo-
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (2) + İ	Ü (2)				
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
examin prox. 15	ation o ; minut ge of a	f one candidate each (ap es per candidate). ssessment: German and,	prox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Focuses AT,ES	s availa	able for students of the N	laster's programme li	nformatik (Computer	Science, 120 ECTS credits):
Worklo	ad				
150 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	ars in			
	-	ee (1 major) Computer Sc			
	-	ee (1 major) Mathematics			
	-	ee (1 major) Computation			ork Pousia (END) (2014)
		ning degree Gymnasium I Ty course MINT Teacher Eo			
		ee (1 major) Computer Sc		verwork Davalla (ENI	U) (2010)
	-	ee (1 major) Computer Sc			
	-	ee (1 major) Computation		9)	
Master'	s degr	ee (1 major) Mathematics	(2019)		

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computational Mathematics (2022)

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

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

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

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

Robotics 1     10-I=RO1-152-mo1       Module coordinator     Module offered by					
Madula coordinator					
Module coordinator Module offered by					
holder of the Chair of Computer Science XVII Institute of Computer Science					
ECTS Method of grading Only after succ. compl. of module(s)					
8 numerical grade					
Duration Module level Other prerequisites					
1 semester graduate					
Contents					
History, applications and properties of robots, direct kinematics of manipulators: coordinate systems, rotations, homogenous coordinates, axis coordinates, arm equation. Inverse kinematics: solution properties, end effector configuration, numerical and analytical approaches, examples of different robots for analytical approaches. Workspace analysis and trajectory planning, dynamics of manipulators: Lagrange-Euler model, direct and inverse dynamics. Mobile robots: direct and inverse kinematics, propulsion system, tricycle, Ackermann steering, holonomes and non-holonome restrictions, kinematic classification of mobile robots, posture kinematic model. Movement control and path planning: roadmap methods, cell decomposition methods, potential field methods. Sensors: position sensors, speed sensors, distance sensors.					
Intended learning outcomes					
The students master the fundamentals of robot manipulators and vehicles and are, in particular, familiar with their kinematics and dynamics as well as the planning of paths and task execution.					
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)					
V (4) + Ü (2)					
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whethe module is creditable for bonus)					
written examination (approx. 60 to 90 minutes) creditable for bonus					
Allocation of places					
Additional information					
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): IS,ES,LR,HCI					
Workload					
240 h					
Teaching cycle					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					
§ 22    Nr. 3 b)					
Module appears in					
Master's degree (1 major) Space Science and Technology (2015)					
First state examination for the teaching degree Gymnasium Computer Science (2015)					
Master's degree (1 major) Computer Science (2016)					
Master's degree (1 major) Mathematics (2016)					
Master's degree (1 major) Computational Mathematics (2016)					
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master's degree (1 major) Computer Science (2017)					
Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Satellite Technology (2018)					
Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- (2019) cord Master (120 ECTS) Computational Mathematics - 2019					



Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	title				Abbreviation
Robotic	:5 2				10-l=RO2-152-m01
Module	coord	inator		Module offered by	
Module coordinator holder of the Chair of Computer Science XVII			e X\/II	Institute of Comput	er Science
ECTS		od of grading	Only after succ. com	· · · · ·	
8		rical grade			
Duration Module level Other prerequisites					
1 semes		graduate			
Conten		Sidduite			
Foundations of dynamic systems, controllability and observability, controller design through pole assignment: feedback and feed-forward, state observer, feedback with state observer, time discrete systems, stochastic systems: foundations of stochastics, random processes, stochastic dynamic systems, Kalman filter: derivation, in- itialising, application examples, problems of Kalman filters, extended Kalman filter.					
Intende	ed leari	ning outcomes			
tions of se the c	<sup>r</sup> oboti connec	cs. The students possess tions between the dual p	a knowledge of adva airs controllability - o	anced controller and bservability as well	filters and their use in applica- observer methods and recogni- as controller design and observer e estimator and an observer.
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) + l	Ü (2)				
		e <b>essment</b> (type, scope, langua; le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
written credital		nation (approx. 60 to 90 i bonus	minutes)		
Allocati	ion of p	olaces			
Additio	nal inf	ormation			
Focuses ES, LR	s availa	able for students of the M	laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits): IT,
Worklo	ad				
240 h					
Teachir	ng cycl	e			
Referre	d to in	LPOI (examination regulations	s for teaching-degree program	mmes)	
§ 22    N	Vr. 3 b)				
Module	appea	ins in			
	-	ee (1 major) Space Scienc		-	
		mination for the teaching		Computer Science (2	2015)
	-	ee (1 major) Computer Sc ee (1 major) Mathematics			
	-	ee (1 major) Computation		6)	
		ning degree Gymnasium I			
		y course MINT Teacher Ed		Network Bavaria (ENI	B) (2016)
	-	ee (1 major) Computer Sc ee (1 major) Computer Sc			
	-	ee (1 major) Computation		9)	



Master's degree (1 major) Mathematics (2019)

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

Module title Abbreviation								
Discret	e Even	Simulation			10-I=ST-161-m01			
Module	e coord	inator		Module offered by				
holder	of the (	Chair of Computer Scie	nce III	Institute of Comput	er Science			
ECTS	Metho	od of grading	Only after succ. con	Only after succ. compl. of module(s)				
8	nume	rical grade						
Duratio	n	Module level	Other prerequisites					
1 seme	ster	graduate						
Conten	ts	0						
Introduction to simulation techniques, statistical groundwork, creation of random numbers and random variables, random sample theory and estimation techniques, statistical analysis of simulation values, inspection of measured data, planning and evaluation of simulation experiments, special random processes, possibilities and limits of model creation and simulation, advanced concepts and techniques, practical execution of simulation projects.						spection of sibilities and		
Intende	ed lear	ning outcomes						
	cal) sys	stems, the evaluation o	knowledge and the pra- f results and the correc					
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Gei	rman)				
V (4) +	Ü (2)							
		<b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether		
lf anno examin prox. 15	unced ation c 5 minut ge of a	f one candidate each ( es per candidate). ssessment: German ar	eginning of the course, approx. 20 minutes) or					
Allocat								
	<u></u>							
Additio	nal inf	ormation						
	s availa		Master's programme I	nformatik (Computer	Science, 120 ECTS (	credits):		
Worklo	ad							
240 h								
Teachi	ng cycl	e						
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)				
Module	e appea	urs in						
		ee (1 major) Computer	Science (2016)					
Master	's degr	ee (1 major) Mathemat	ics (2016)					
Master's degree (1 major) Computational Mathematics (2016)								
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)								
		•	Education PLUS, Elite	Network Bavaria (ENI	B) (2016)			
	-	ee (1 major) Computer						
	-	ee (1 major) Computer		enerated 19-Apr-2025 • exam	reg data ro	name 222 / 246		
(2019)	an i majo			ECTS) Computational Mathen	-	page 233 / 349		

Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) eXtended Artificial Intelligence (xtAl) (2020)

Module	title				Abbreviation		
Real-Time Interactive Systems 10-HCI=RIS-161-m01							
		-					
Module				Module offered by			
ECTS		Chair of Computer Scienc od of grading	Only after succ. com	Institute of Comput			
		rical grade	Unity after Succ. con				
5 Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		Sidduce					
human Reality, tive Sys The cou hands- concen What a RIS? Wh tual mo stem's and the part int Along t This inc compon	This course provides an introduction into the requirements, concepts, and engineering art of highly interactive human-computer systems. Such systems are typically found in perceptual computing, Virtual, Augmented, Mixed Reality, computer games, and cyber-physical systems. Lately, these systems are often termed Real-Time Interactive Systems (RIS) due to their common aspects. The course covers theoretical models derived from the requirements of the application area as well as common hands-on and novel solutions necessary to tackle and fulfill these requirements. The first part of the course will concentrate on the conceptual principles characterizing real-time interactive systems. Questions answered are: What are the main requirements? How do we handle multiple modalities? How do we define the timeliness of RIS? Why is it important? What do we have to do to assure timeliness? The second part will introduce a conceptual model of the mission-critical aspects of time, latencies, processes, and events necessary to describe a system's behavior. The third part introduces the application state, it's requirements of distribution and coherence, and the consequences these requirements have on decoupling and software quality aspects in general. The last part introduces some potential solutions to data redundancy, distribution, synchronization, and interoperability. Along the way, typical and prominent state-of-the-art approaches to reoccurring engineering tasks are discussed. This includes pipeline systems, scene graphs, application graphs (aka field routing), event systems, entity and component models, and others. Novel concepts like actor models and ontologies will be covered as alternative solutions. The theoretical and conceptual discussions will be put into a practical context of today's commercial						
Intende	ed lear	ning outcomes					
physiol gical ch can exp to solve	ogical haracte bect fro e a give	and psychological charac ristics of today's comput m today's technological	cteristics of the huma er systems. Participa solutions. They will b s application area an	n users as well as b nts will gain a solid e able to choose the d they will have a we	conditions defined by both, the y the architectures and technolo- understanding about what they e appropriate approach and tools ell-founded basis enabling them		
Course	<b>S</b> (type, r	number of weekly contact hours, l	anguage — if other than Ger	man)			
V (2) +	. ,						
		<b>sessment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	ot every semester, information on whether		
written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus							
Allocat	Allocation of places						
Additio	nal inf	ormation					

## Workload

150 h

Teaching cycle

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

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## Module appears in

Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module title				Abbreviation		
Software Architecture 10-I=SAR-161-m01						
Module coordinator			Module offered by			
holder	of the (	Chair of Computer Scier	nce II	Institute of Comput	er Science	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
tural st sed sof cloud-r model-	yles, so ftware o native a driven	o software architecture, oftware components, in engineering, service-ori and serverless computir architecture	terface models and de ented architectures, m	sign guidelines, des icroservice architect	ign-by-contract, com ures, scalability of d	iponent-ba- atabases,
Intende	ed lear	ning outcomes				
		possess a fundamental n modern software arch				
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ge	rman)		
V (2) +	Ü (2)					
		<b>eessment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
lf anno examin prox. 1	unced ation c 5 minut ge of a	nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a ces per candidate). ssessment: German an bonus	eginning of the course, approx. 20 minutes) or			
Allocat						
Additio	nal inf	ormation				
	s availa	able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS (	credits):
Worklo	ad					
150 h						
Teachi	ng cvcl	e				
	,					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
§ 22    Nr. 3 b)						
Module appears in						
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)						
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 237 / 349

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Module studies (Master) Computer Science (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Information Systems (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computer Science (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Management (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Information Systems (2024) Master's degree (1 major) Economathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Information Systems (2025) Master's degree (1 major) Management (2025) Master's degree (1 major) Computer Science (2025) Master's degree (1 major) Economathematics (2025)

Module title			Abbreviation			
Machi	ne Lear	ning (for User Interfaces	5)		10-HCI=MLUI-161-n	101
Modu	e coord	inator		Module offered by	л	
holder	of the (	Chair of Computer Scien	nce IX Institute of Computer Science			
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade		-		
Durati		Module level	Other prerequisites	;		
1 sem	ester	graduate				
Conte			1			
vastly ly use all are gestur wards In this pleme but als Finally and Al This co Topics nels, r deep l learnin how to standi	improve it dozer as wher e, spee human course nting th so gain , they le burse pr include neural n earning ng and A o apply l ng (web	e learning has given us ed understanding of the ns of times a day withou re the understanding of ch, or eye-gaze, is parar -level AI. , students will learn abo tem and getting them to the practical know-how earn about some of Silic rovides a broad introduc e: (i) Supervised learning etworks). (ii) Unsupervise ). (iii) Best practices in r AI). The course will also learning algorithms to b o search, anti-spam), sm mining, and other areas	human genome. Mac t knowing it. It is one user input of high vari nount. Many research ut the most effective r work. Students not or needed to quickly and on Valley's best practi- ction to machine learn g (parametric/non-par sed learning (clusterin nachine learning (bias draw from numerous of uilding gesture-based nart robots (perceptior	hine learning is so po of today's prominent ability, specifically for ers also think it is the machine learning tec hy learn the theoretic powerfully apply the ices in innovation as ing, data-mining, and rametric algorithms, g, dimensionality rec s/variance theory; in case studies and app and multimodal inter	ervasive today that y paradigms in HCI a or natural interaction e best way to make hniques, and gain p cal underpinnings o ese techniques to ne it pertains to mach d statistical pattern support vector mach duction, recommend novation process in plications, so that yo erfaces, text and spe	you probab- pplicable in ns using, e.g., progress to- practice im- f learning, ew problems, ine learning recognition. nines, ker- der systems, machine pu'll also learn eech under-
		ning outcomes	<u>.                                    </u>			
After t gies, e Stude	he cour e.g., like nts will	se, the students will be Octave. In addition, the be able to choose the a ion area, specifically in	ey will be able to deriv ppropriate approach a	e main principles an	d apply these in owi	n programs.
Course	<b>es</b> (type, r	number of weekly contact hours	, language — if other than Ge	rman)		
	d of ass	<b>sessment</b> (type, scope, langu le for bonus)	uage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether
Langu		of project results (appro ssessment: German and bonus	•			
Alloca	tion of <sub>l</sub>	places				
	es avail	ormation able for students of the	Master's programme I	nformatik (Computer	r Science, 120 ECTS	credits):
Workl						
150 h						
Master's v (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 239 / 349

# Teaching cycle

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

§ 22    Nr. 3 b)	
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Module appears in
Master's degree (1 major) Computer Science (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Computer Science (2017)
Master's degree (1 major) Computer Science (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computer Science (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Computer Science (2023)
Master's degree (1 major) Computational Mathematics (2024)
Master's degree (1 major) Mathematics (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Master's degree (1 major) Computer Science (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title Abbreviation							
Visualization of Graphs     10-I=VG-161-m01							
Module	e coord	inator		Module offered by			
holder	of the (	Chair of Computer Scie	nce l	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)			
5	nume	rical grade					
Duratio		Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
<i>phenth</i> the pla	<i>eorie (/</i> nar sep	Algorithmic Graph Theo	nt algorithms to draw g ory) such as divide and used. We will become se measures.	conquer, flow netwo	orks, integer program	nming and	
Intende	ed leari	ning outcomes					
			raph visualisation and and solving of probler				
Course	<b>S</b> (type, n	number of weekly contact hour	s, language — if other than Ger	rman)			
V (2) +	Ü (2)						
		<b>sessment</b> (type, scope, lang le for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether	
examin prox. 1	ation o 5 minut ge of a	of one candidate each ( es per candidate). ssessment: German ar	eginning of the course, approx. 20 minutes) or id/or English				
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Focuse AT,IT,H		able for students of the	Master's programme l	nformatik (Computer	Science, 120 ECTS o	credits):	
Worklo	ad						
150 h							
Teachi	ng cycl	е					
Referre	d to in	LPO I (examination regulati	ons for teaching-degree progra	mmes)			
§ 22	Nr. 3 b)						
Module appears in							
Master's degree (1 major) Computer Science (2016)							
Master's degree (1 major) Mathematics (2016)							
Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Cympasium MINT Teacher Education RUUS, Elite Network Payaria (ENP) (2016)							
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)							
	Master's degree (1 major) Computer Science (2017)						
	Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)						
	-		onal Mathematics (201	9)			
		ee (1 major) Mathemat					
Master's wi (2019)	ith 1 majoi	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 241 / 349	

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computer Science (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Computer Science (2023)

Master's degree (1 major) Mathematical Data Science (2025)

Module title Abbreviation							
Selected Topics in Algorithms 10-I=AKA-161-m01							
Module	e coord	inator		Module offered by	<u>.</u>		
holder	of the (	Chair of Computer Scie	nce l	Institute of Comput	er Science		
ECTS	1	od of grading	Only after succ. con	· · · ·			
5	1	rical grade					
Duratio		Module level	Other prerequisites				
1 seme		graduate					
Conten		gladuate					
		s in algorithmics.					
		ning outcomes					
		understand the basic a omplex problems in thi				erstand the	
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Gei	rman)			
V (2) +	Ü (2)						
		sessment (type, scope, lang	uage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether	
	-	le for bonus)					
		nation (approx. 60 to 12 by the lecturer at the be		the written examina	tion may be replace	d by an oral	
		of one candidate each (					
		tes per candidate).					
		ssessment: German an	d/or English				
	ble for						
Allocat	tion of <sub>l</sub>	olaces					
Additio	onal inf	ormation					
Focuse AT	es availa	able for students of the	Master's programme I	nformatik (Computer	r Science, 120 ECTS o	credits):	
Worklo	ad						
150 h							
	ng cycl	e					
		•					
Poforra	d to in	<b>LPO I</b> (examination regulation					
Referre		LFUT (examination regulation	ons for teaching-degree progra	mmes)			
		•					
	e appea		$\sim$				
	-	ee (1 major) Computer (					
	-	ee (1 major) Mathemati		6)			
Master's degree (1 major) Computational Mathematics (2016)							
Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018)							
Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019)							
	-	ee (1 major) Mathemati		~			
	-	hing degree Gymnasiur	-	ion PLUS, Elite Netw	ork Bavaria (ENB) (20	020)	
Supple	Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)						
	-	ee (1 major) Aerospace	•	20)			
Master	's degr	ee (1 major) Computer S	Science (2021)				
Master's w (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 243 / 349	



Master's degree (1 major) Aerospace Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Module title A					Abbreviation	
Selected Topics in Theory 10-I=AKT-161-mo1						
Modul	e coord	inator		Module offered by	<u> </u>	
holder	of the (	Chair of Computer Scie	nce l	Institute of Comput	er Science	
ECTS		od of grading	Only after succ. con			
5	1	rical grade		•		
Duratio		Module level	Other prerequisites			
1 seme	ester	graduate				
Conter		0	1			
-		s in theory.				
		ning outcomes				
			 pproach of theoretical	computer science. Th	nev are able to unde	rstand the
			s area and apply them			
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (2) +	Ü (2)					
Metho	d of ass	sessment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
		le for bonus)			· · ·	
		nation (approx. 60 to 1				
			eginning of the course,			
		tes per candidate).	approx. 20 minutes) or	an oral examination	in groups of 2 cand	idates (ap-
		ssessment: German ar	nd/or English			
	ble for					
Allocat	tion of p	olaces				
Additio	onal inf	ormation				
Focuse	es availa	able for students of the	Master's programme I	nformatik (Computer	Science, 120 ECTS	credits):
AT						
Worklo	ad					
150 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ummes)		
Modul	e appea	ars in				
Master	's degr	ee (1 major) Computer	Science (2016)			
	-	ee (1 major) Mathemat				
Master's degree (1 major) Computational Mathematics (2016)						
Master's degree (1 major) Computer Science (2017)						
Master's degree (1 major) Computer Science (2018)						
Master's degree (1 major) Computational Mathematics (2019)						
Master's degree (1 major) Mathematics (2019)						
	Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)					
	Master's degree (1 major) Aerospace Computer Science (2020)					
	-	ee (1 major) Computer	•			
						· · · · ·
Master's w (2019)	nin 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 245 / 349



Master's degree (1 major) Aerospace Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Module title         Abb			Abbreviation			
Security of Software Systems 10-I=SSS-172-m01						
Modul	e coord	inator		Module offered by		
holder	ofthe	Chair of Computer Scier	nce II Institute of Computer Science			
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
5	nume	rical grade				
Durati	on	Module level	Other prerequisites			
1 seme	ester	graduate				
Conter	nts					
dern co the fol • F • F • F • F • F • F • F • F • F • F	<ul> <li>Runtime attacks (code injection, code reuse, defenses)</li> <li>Web security</li> <li>Blockchains and smart contracts</li> <li>Side-channel attacks</li> </ul>					
tive.		lents to gain hands-on			items from an attack	er's perspec-
		number of weekly contact hours	s, language — if other than Ger	man)		
V (2) + Modul		t in: English				
		<b>Sessment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
		le for bonus)			· ·	
lf anno examir prox. 1 Langua	written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: English creditable for bonus					
Alloca	tion of <sub>l</sub>	places				
Additio	onal inf	ormation				
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, LR, HCI, ES. Basic programming knowledge in C is required.						
Workload						
150 h						
Teaching cycle						
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Modul	e appea	ars in				
Master's w (2019)	vith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather		page 247 / 349

Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Aerospace Computer Science (2020) Master's degree (1 major) eXtended Artificial Intelligence (xtAl) (2020)

Module	title				Abbreviation		
Machine Learning for Natural Language Processing       10-I=NLP-182-m01							
Module	e coord	inator		Module offered by			
Dean o	f Studi	es Informatik (Compute	er Science)	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
ents sta ground almost beddin ke CNN training applica	The lecture conveys advanced knowledge about methods in computational text processing. To this end, it pres- ents state of the art models and techniques in the area of machine learning, as well as their technical back- ground, and their respective applications in Natural Language Processing. As one important building block of almost all modern NLP-models, different techniques for learning representations of words, so called Word Em- beddings, are presented. Starting from this we cover, among others, models from the area of Deep Learning, li- ke CNNs, RNNs and Sequence-to-Sequence architectures. The theoretical foundations of these models, like their training with Backpropagation, are also covered in depth. For all models presented in the lecture, we show their application to problems like sentiment analysis, text generation and machine translation in practice.						
		ning outcomes					
			ge on problems and me itable methods for a sp		computational text	orocessing	
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Gei	man)			
V (2) +	Ü (2)						
module is written If annot examin prox. 15	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. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English						
Allocat	ion of p	olaces					
Additio	nal inf	ormation					
Focuse: IS, HCI.		able for students of the	Master's programme l	nformatik (Computer	Science, 120 ECTS o	credits): AT,	
Worklo	ad						
150 h							
Teachir	ıg cycl	e					
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module appears in							
Master Master Master Master	's degr 's degr 's degr 's teacl	ee (1 major) Mathemati ee (1 major) Informatio	onal Mathematics (201 cs (2019) n Systems (2019) n MINT Teacher Educat	-			
(2019)	ai i iliaju			ECTS) Computational Mather	•	page 249 / 349	



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

Master's with 1 major Computational Mathematics (2019)

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Computational Mathematics - 2019

Module control         Module offered by           holder of the Chair of Computer Science III         Institute of Computer Science           ECTS         Method of grading         Only after succ. compl. of module(s)           5         numerical grade            Duration         Module Evel         Other prerequisites           1 semester         graduate         We recommend completing module 10-1–PRIAK in parallel.           Contents         Project goals, project asgingment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project organisation, team building and development, opportunity and risk management, quality management, project profolio management, MONS, project management, project profolio management, MONS, project management, project profolio management, MONS, project management, project profolio management, MONS, project management, project profolio management, MONS, proseses practically relevant knowledge about the topics of production management and/or profesional project management, mality and the critical success criteria and are able to initiate, define, plan, control and review projects.           Curress (type, number of weekly contact hours, language – if other than German)         V (a)           Method of assessment (kype, scope, language – if other than German)         V (a)           Method of assessment (kype, scope, language – if other than German)         V (a)           Method of assesessment (kype, scope, language – if other than German)<	Module	title				Abbreviation	
holder of the Chair of Computer Science III Institute of Computer Science  ECTS Method of grading Only after succ. compl. of module(s) Innumerical grade Innumerical grade Innumerical grade Isomester graduate We recommend completing module 10-1=PRJAK in parallel.  Contents Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project com- munication and marketing, project organisation, team building and development, opportunity and risk management, contract and procurement management, quality management, work techniques, methods and tools; leadership and social skills in project management, quality management, work techniques, methods and tools; leadership and social skills in project management, project management/SCRUM, combination of classic and agite methods. Intended learning outcomes The students possess practically relevant knowledge about the topics of production management and/or professional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects. Courses (type, number of weekly contact hours, language – if other than German) V (a) Method of assessment (type, scepe, language – if other than German) V (a) Method of assessment: German and/or English creditable for bonus) Mitten examination (approx, 6o to 120 minutes). If anounced by the lecturer at the beginning of the course, the written examination in groups of 2 candidates (approx, 1970, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000, 200	Professional Project Management 10-I=PM-182-mo1						
ECTS         Method of grading         Only after succ. compl. of module(s)           5         numerical grade	Module	coord	inator		Module offered by		
5       numerical grade          Duration       Module level       Other prerequisites         1 semester       graduate       We recommend completing module 10-1=PRJAK in parallel.         Contents       Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project corganisation, team building and development, opportunity and risk management, yoriget corganisation, team building and development, opportunity and risk management, project success criteria and procurement management, project success; gille project management, XCRUM, combination of classic and agite methods.         Intended learning outcomes       Intended learning outcomes         The students possess practically relevant knowledge about the topics of production management and/or professional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects.         Courses (type, number of weekly contact hours, language – if other than German)       V (4)         Method of assessment (type, scope, language – if other than German)       V (4)         Method of assessment (type, scope, language – if other than German)       V (4)         Method of assessment (type, scope, language – if other than German)       V (4)         Method of assessment (type, scope, language – if other than German)       V (4)         Method of assessment of type, scope, language – if other than German) <td>holder</td> <td>of the O</td> <td>Chair of Computer Scie</td> <td>nce III</td> <td>Institute of Comput</td> <td>er Science</td> <th></th>	holder	of the O	Chair of Computer Scie	nce III	Institute of Comput	er Science	
Duration         Module level         Other prerequisites           1 semester         graduate         We recommend completing module 10-I=PRJAK in parallel.           Contents         Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management, project and crisis management, molica and crisis management, project porton management, molica and crisis management, project porton management, molica and procurement management, project siggle project management, project portofic management, Projects; agile project management, Project portofic management, Projects; agile project management. Novel cape and claim management, Projects; agile project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and revelw projects.           Courses (type, number of weekly contact hours, language – if other than German)         V (4)           Method of assessment (type, scope, language – if other than German, examination offerd – if not every semester, information on whether module is creditable for bonus)           Written examination (approx. 6 to to 20 minutes).           If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of places                    Additional information           Fore to bonus           Addit	ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
Duration         Module level         Other prerequisites           1 semester         graduate         We recommend completing module 10-1=PRJAK in parallel.           Contents         Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management, multiproject management, colorat and procurement management, multiproject management, polycer thanagement, projects; agile project management, SCRUM, combination of classic and agile methods.           Intended learning outcomes         Intended learning outcomes           The students possess practically relevant knowledge about the topics of production management and/or professional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects.           V(a)         Method of assessment (type, scope, language – if other than German)         V(q)           Method of assessment (type, scope, language – if other than German, examination offered – if not every senester, information on whether module is creditable for bonus         Mittine examination (approx. 6 to 120 minutes).           If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of nore candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes) per candidates (approx. 15 minutes) per candidate.           Additional information	5	nume	rical grade				
1 semester       graduate       We recommend completing module 10-1=PRJAK in parallel.         Contents       Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management; conflict and crisis management, change and claim management, contract and procurement management, project management, project portfolio management, PMOs; peculiarities of software projects, agile project management, project portfolio management, PMOs; peculiarities of software projects, agile project management, They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects.         Courses (type, number of weekly contact hours, language – if other than German)       V (4)         Method of assessment (type, scope, language – if other than German)       V (7)         Method of assessment (type, scope, language – if other than German)       V (7)         Method of assessment (sperox. 60 to 120 minutes).       If anounced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 10 minutes) or an oral examination in groups of 2 candidates (approx. 13 minutes per candidate).         Language of assessment:       German and/or English creditable for bonus         Aldictional information       German and/or English creditable for students of the Master's programme Informatik (Com		n	Module level	Other prerequisites			
Contents         Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management, conflict and crisis management, change and claim management, contract and procurement management, program management, multiproject management, project profolio management, project management, project management, project profolio management, PMOS; peculiarities of software projects; agile project management, PCRUM, combination of classic and agile methods.         Intended learning outcomes       Intended learning outcomes         The students possess practically relevant knowledge about the topics of production management and/or professional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects.         Courses (type, number of weekly contact hours, language – if other than German)       V (4)         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 of prox. 6 to 120 minutes).         If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 3 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).         Language of assessment: German and/or English creditable for bonus	1 seme	ster	graduate		pleting module 10-1	=PRJAK in parallel.	
Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project com- munication and marketing, project organisation, team building and development, opportunity and risk manage- ment; conflict and crisis management, change and claim management; contract and procurement management, quality management, multiproject management, project portfolio management, PMOs; peculiarities of software program management, multiproject management, project portfolio management, PMOs; peculiarities of software projects; agile project management/SCRUM, combination of classic and agile methods. Intended learning outcomes The students possess practically relevant knowledge about the topics of production management and/or pro- fessional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects. Courses (type, number of weekly contact hours, language – if other than German) V (a) Method of assessment (type, scope, language – if other than German) V (b) I announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes)) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus Allocation of places  Moditional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle  Medie appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2019) Master's degree (1 major) Computer Science (2019) Master's degree (1 major) Computer Science (2019) Master's	Conten	ts	5	l	1 0	2	
The students possess practically relevant knowledge about the topics of production management and/or pro- fessional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects. <b>Courses</b> (type, number of weekly contact hours, language – if other than German) V (a) <b>Method of assessment</b> (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus <b>Aldottional information</b> Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. <b>Workload</b> 150 h <b>Teaching cycle</b>  <b>Module appears in</b> Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Management (2018) Master's degree (1 major) Management (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) M	Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management; conflict and crisis management, change and claim management; contract and procurement management, quality management, work techniques, methods and tools; leadership and social skills in project management, program management, multiproject management, project portfolio management, PMOs; peculiarities of software projects, agile project management/SCPLIM, combination of classic and agile methods.						
The students possess practically relevant knowledge about the topics of production management and/or pro- fessional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects. <b>Courses</b> (type, number of weekly contact hours, language – if other than German) V (a) <b>Method of assessment</b> (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus <b>Aldottional information</b> Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. <b>Workload</b> 150 h <b>Teaching cycle</b>  <b>Module appears in</b> Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Management (2018) Master's degree (1 major) Management (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Computational Mathematics (2019) M	Intende	ed learr	ning outcomes				
V (4)  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. 6o to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus  Allocation of places  Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)	The stu fession	dents p al proje	oossess practically rele ect management. They				
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. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus Allocation of places  Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's degree (1 major) Information Systems (2019) Master's degree (1 major) Information Systems (2019)	Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ger	rman)		
module is creditable for bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Mathemati	V (4)						
Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO 1 (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)	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. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Language of assessment: German and/or English						
Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)	Allocat	ion of p	olaces				
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's vith 1 major Computational Mathematics MUWürzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349							
IT, IS, ES, LR, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics MUWürzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349	Additio	nal info	ormation				
150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics MMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251/349				Master's programme l	nformatik (Computer	Science, 120 ECTS o	credits): SE,
Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computer Science (2018)         Master's degree (1 major) Management (2018)         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Information Systems (2019)         Master's with 1 major Computational Mathematics         Mu Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 251 / 349	Worklo	ad					
Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's degree (1 major) Computer Science (2018)         Master's degree (1 major) Management (2018)         Master's degree (1 major) Computational Mathematics (2019)         Master's degree (1 major) Mathematics (2019)         Master's degree (1 major) Information Systems (2019)         Master's with 1 major Computational Mathematics         JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 251 / 349	150 h						
 Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349	Teachir	ng cycl	e				
Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349							
Module appears in Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-							
Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	Module appears in						
Master's degree (1 major) Management (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-				Science (2018)			
Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019) Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349		-					
Master's degree (1 major) Information Systems (2019)         Master's with 1 major Computational Mathematics       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-       page 251 / 349	Master's degree (1 major) Computational Mathematics (2019)						
Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 251 / 349	Master's degree (1 major) Mathematics (2019)						
		-	-				
	Master's wi (2019)	in 1 major	computational Mathematics				page 251 / 349



Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) exchange program Business Management and Economics (2022)

Module title				Abbreviation	
Project	Project - Current Topics in Computer Science				10-I=PRJAK-162-m01
Module	coord	inator		Module offered by	
Dean of	fStudie	es Informatik (Computer S	Science)	Institute of Comput	er Science
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
Comple	Completion of a project task (in Teams).				
Intende	ed learı	ning outcomes			
The pro	ject all	ows participants to work	on a problem in com	puter science in tear	ms.
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
P (4)					
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
Each pr same to Langua	oject is opic. As ge of a		he project will not be , only be offered for t /or English	repeated; there will he project offered in	not be another project with the the respective semester.
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
		able for students of the N _R, HCI, GE.	laster's programme Ir	nformatik (Computer	Science, 120 ECTS credits): AT,
Worklo	ad				
150 h					
Teachir	ng cycl	e			
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)	
Module	appea	ars in			
		ee (1 major) Computer Sc	ience (2016)		
Master	s degr	ee (1 major) Computer Sc	ience (2017)		
	-	ee (1 major) Computer Sc			
	-	ee (1 major) Management		、 、	
	-	ee (1 major) Computation		9)	
	-	ee (1 major) Mathematics			
		ee (1 major) Media Comm			
	-	ee (1 major) Information S ning degree Gymnasium I		on PLUS Flite Netwo	ork Bayaria (ENB) (2020)
		y course MINT Teacher E			
- appic					-,

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Module title				Abbreviation			
NLP and	d Text	Mining			10-I=STM-162-m01		
Module	e coord	inator		Module offered by			
holder	of the (	Chair of Computer Scier	ice VI	VI Institute of Computer Science			
ECTS	Metho	od of grading	Only after succ. com	Only after succ. compl. of module(s)			
5	nume	rical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate	 				
Conten	I	3					
Foundations in the following areas: definition of NLP and text mining, properties of text, sentence boundary de- tection, tokenisation, collocation, N-gram models, morphology, hidden Markov models for tagging, probabili- stic parsing, word sense disambiguation, term extraction methods, information extraction, sentiment analysis. The students possess theoretical and practical knowledge about typical methods and algorithms in the area of text mining and language processing mostly for English. They are able to solve problems through the methods taught. They have gained experience in the application of text mining algorithms.							
Intende	ed leari	ning outcomes					
text mi	The students possess theoretical and practical knowledge about typical methods and algorithms in the area of text mining and language processing. They are able to solve practical problems with the methods acquired in class. They have gained experience in the application of text mining algorithms.						
Course	<b>Courses</b> (type, number of weekly contact hours, language — if other than German)						
V (2) + Ü (2)							
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)							
written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English							
Allocat							
Additio	nal inf	ormation					
		able for students of the	Master's programme li	nformatik (Computer	Science, 120 ECTS o	redits): AT,	
Worklo	ad						
150 h							
Teachi	ng cvcl	6					
	0 . /	-					
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)			
§ 22	Nr. 3 b)						
Module	e appea	irs in					
Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Information Systems (2019)							
		ning degree Gymnasiun		on PLUS, Elite Netwo		020) page 254 / 349	
(2019)	an i majul			ECTS) Computational Mathem	-	pase 254 / 349	



Master's degree (1 major) Computer Science (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Information Systems (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Computer Science (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's degree (1 major) Information Systems (2024) Master's degree (1 major) Information Systems (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Master's degree (1 major) Mathematical Data Science (2025)



# **Application Subject Physik**

(ECTS credits)

Module	Module title				Abbreviation	
Image	and Sig	gnal Processing in Phys	sics		11-BSV-161-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
and im convolu	age pro ution p bservat	aperiodic signals; princ ocessing; discretisation roduct; tapering functic tion; statistical signals, n.	of signals/sampling to ons and interpolation o	heorem (Shannon); ł f images; the Parsiva	nomogeneous and li al theorem, correlation	near filters, on and ener-
Intende	ed lear	ning outcomes				
les of ir	mage p	have advanced knowled rocessing and are fami Is and to implement the	liar with different meth	ods of signal proces		
Course	<b>S</b> (type, r	number of weekly contact hours	s, language — if other than Ge	rman)		
V (2) +						
		t in: German or English				
		sessment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
<ul> <li>module is creditable for bonus)</li> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocat	ion of <sub>l</sub>	places				
Additio	onal inf	ormation				
	-					
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Module						
	-	ee (1 major) Mathemati ee (1 major) Physics (20				
Master's wi (2019)	ith 1 majo	r Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 257 / 349

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

Module title Abbreviation						
Quantu	Im Info	rmation Technology			11-QUI-161-m01	
Module	e coordi	inator		Module offered by		
Managi	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numei	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Basic concepts of quantum mechanics, quantum bits and algorithms, quantal measurements, experimental ap- proaches towards quantum computing (on the basis of photons, ions and nuclear spins), quantum operations and quantum noise, quantum information and communication.						
Intende	ed learr	ning outcomes				
	xperim	are familiar with the bas ental approaches for th				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	rman)		
V (3) + R (1) Module taught in: German or English						
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)						
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocat		laces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycle	<b>a</b>				
Referre	d to in	<b>IPOI</b> (examination regulation	ons for teaching-degree progra	mmes)		
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module	annea	rs in				
Master Master Master Master	Module appears in         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Physics (2016)         Master's degree (1 major) Nanostructure Technology (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's with 1 major Computational Mathematics         JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 259 / 349					
(2019)				ECTS) Computational Mathem	-	page 259 / 349

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	e title				Abbreviation	
Physic	s of Adv	vanced Materials			11-PMM-161-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
and su	General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.					
Intend	ed learı	ning outcomes				
The stu	idents l	know the properties an	d characterization met	nods of some moder	n materials.	
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ge	man)		
V (3) + Module		t in: German or English				
		s <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
e) pres If a writ stead t of asse nation Langua	<ul> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	ars in				
Master Master Master Master Master	's degro 's degro 's degro 's degro 's teach	ee (1 major) Mathemati ee (1 major) Physics (20 ee (1 major) Nanostruct ee (1 major) Computatio ee (1 major) Functional ning degree Gymnasiur	016) ure Technology (2016) onal Mathematics (201 Materials (2016) n MINT Teacher Educat			016) page 261 / 349
(2019)			cord Master (120	ECTS) Computational Mathen	natics - 2019	

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

UNIVERSITÄT

WÜRZBURG

Module title					Abbreviation	
Spintro	nics				11-SPI-161-m01	
Module	coordi	nator		Module offered by		
Managi	ng Dire	ctor of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	d of grading	Only after succ. con	pl. of module(s)		
6	numer	ical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts		_			
This lecture covers the basic principles of spin transport, with a particular emphasis on the phenomena of giant magnetoresistance and tunnel magnetoresistance. As a last point, we discuss new phenomena from the field of spin dynamics and current-induced spin phenomena.						
Intende	d learr	ing outcomes				
mation	techno	now the basic principl logy. They have gainec sistance).				
Courses	<b>5</b> (type, n	umber of weekly contact hours	, language — if other than Ger	man)		
V (3) + R (1) Module taught in: German or English						
<b>Method of assessment</b> (type, scope, language – if other than German, examination offered – if not every semester, information on whether module is creditable for bonus)						
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>If a written examination was chosen as method of assessment, this may be changed and assessment may in-</li> </ul>						
of asses nation o Languag	ssment date at ge of a	form of an oral examin is changed, the lectur the latest. ssessment: German an ffered: In the semester	er must inform student d/or English	s about this by four v	weeks prior to the or	
Allocati	ion of p	laces				
Additio	nal info	ormation				
Workloa	ad					
180 h						
Teachin	ıg cycle	9				
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
Module	appea	rs in				
Master' Master'	s degre s degre	ee (1 major) Mathemati ee (1 major) Physics (20 ee (1 major) Nanostruct ee (1 major) Computatio	16) ure Technology (2016)	6)		
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 263 / 349

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

Module	title				Abbreviation
Solid S	Solid State Physics 2				11-FK2-161-m01
Module	coord	inator		Module offered by	
Managi	ng Dire	ector of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
and exc gation o gnetic a	citation of mag and ele ations	s such as phonons and r netic, orbital and charge ctronic properties of thin	nagnetic waves; reso order; X-ray and neut films and superlattic	nant elastic X-ray sc ron reflectometry; in ces; resonant inelast	atomic and magnetic structure attering and absorption; investi- ivestigation of the structural, ma- ic X-ray scattering; investigation icroscopy"); further topics upon
		ning outcomes			
The stu tering, I	dents l moderr	know different modern so	and neutron reflector	metry and resonant i	ring, resonant elastic X-ray scat- inelastic X-ray scattering. They
Courses	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (4) + I Module		t in: German or English			
Method	l of ass	<b>sessment</b> (type, scope, langua	ge — if other than German, e	examination offered — if no	t every semester, information on whether
		le for bonus)			
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocati	ion of p	olaces			
 Additio	nal info	ormation			
Worklo	ad				
240 h					
Teachir	ng cycl	e			
Referre	Referred to in LPO I (examination regulations for teaching-degree programmes)				
Module	e appea	in			
Master'	s degre	ee (1 major) Mathematics	(2016)		

Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	Module title				Abbreviation	
Solid S	Solid State Spectrocopy				11-FKS-161-m01	
Module	e coord	inator		Module offered by		
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
	Single- and many-particle pictures of electrons in solids, light-matter interaction, optical spectroscopy, electron microscopy, X-ray spectroscopy.					
Intend	ed learr	ning outcomes				
types o	of spect	nave specific and advan roscopy and their fields in research.				
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Gei	man)		
V (3) + Module		t in: German or English				
		e <b>ssment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
d) proje e) pres If a writ stead t of asse nation Langua	<ul> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes)</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Additio	onal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	9				
Referre	ed to in	LPO I (examination regulation	ons for teaching-degree progra	mmes)		
		_	· · · ·			
Module	e appea	rs in				
Master Master Master Master Master	Module appears in Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)					
Master's w (2019)	iti i major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 267 / 349

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

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

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

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

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

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

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

exchange program Physics (2023)

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

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

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

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

Module	Module title				Abbreviation	
Magnetism			11-MAG-161-m01			
Module	e coord	inator		Module offered by		
Managi	ng Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Dia- and paramagnetism, exchange interaction, ferromagnetism, antiferromagnetism, anisotropy, domain struc- ture, nanomagnetism, superparamagnetism, experimental methods to measure magnetic properties, Kondo ef- fect.						
Intende	ed learr	ning outcomes				
experin ches ar	nents; f nd are a	they are skilled in simp able to apply them to ta	epts and phenomena of le model building and isks in the stated areas able to evaluate the ac	in the formulation of ; they have compete	mathematical-phys ncies in independer	ical approa-
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ger	rman)		
V (3) + Module		t in: German or English				
		s <b>essment</b> (type, scope, lang le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
<ul> <li>c) oral of</li> <li>d) projection</li> <li>e) pressed</li> <li>lf a write</li> <li>stead ta</li> <li>of assed</li> <li>nation</li> <li>Langua</li> </ul>	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> </ul>					
Allocat			in which the course is		issequent semester	
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	9				
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
		•				
Module	appea	rs in				
Master Master	Module appears in         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Physics (2016)         Master's degree (1 major) Nanostructure Technology (2016)					
Master's wi (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 269 / 349
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Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) exchange program Physics (2023) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module	Module title				Abbreviation	
Semico	onducto	r Physics			11-HLPH-161-m01	
Module	e coord	nator		Module offered by		
Manag	ing Dire	ctor of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	its					
<ol> <li>Symmetry properties</li> <li>Crystal formation and electronic band structure</li> <li>Optical excitations and their coupling effects</li> <li>Electron-phonon coupling</li> <li>Temperature-dependent transport properties</li> <li>Magnetic semiconductors</li> </ol>						
Intend	ed learr	ing outcomes				
		are familiar with the pri d know their physical p				re of semi-
Course	<b>S</b> (type, n	umber of weekly contact hours	s, language — if other than Ge	rman)		
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						
		le for bonus)				
<ul> <li>b) oral</li> <li>c) oral</li> <li>d) projeting</li> <li>e) pression</li> <li>lf a write stead t</li> <li>of assession</li> <li>nation</li> <li>Languation</li> </ul>	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
	ion of p					
Additio	onal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cyclo	9				
Referre	ed to in	LPOI (examination regulation	ons for teaching-degree progra	ammes)		
Module	e appea	rs in				
	-	ee (1 major) Mathemati ee (1 major) Physics (20				
Master's w (2019)	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 271 / 349
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Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Computational Mathematics (2016) Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	Module title					
Optical	Prope	rties of Semiconductor	Nanostructures		11-HNS-161-m01	
Module	e coord	inator		Module offered by		
Managi	ing Dire	ector of the Institute of	Applied 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	i		
1 seme	ster	graduate				
Conten	ts					
Semiconductor nanostructures are frequently referred to as "artificial materials". In contrast to atoms, molecules or macroscopic crystals, their electronic, optical and magnetic properties can be systematically tailored by chan- ging their size. The lecture addresses technological challenges in the preparation of semiconductor nanostruc- tures of varying dimensions (2D, 1D, oD). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.						
Intende	ed learı	ning outcomes				
knowle	The students know the theoretical principles and characteristics of semiconductor nanostructures. They have knowledge of the technological methods to fabricate such structures, and of their applications to novel photonic devices. They are able to apply their knowledge to problems in this field of research.					
Course	<b>S</b> (type, n	umber of weekly contact hour	s, language — if other than Ge	rman)		
V (3) + Module		t in: German or English				
Method	d of ass	s <b>essment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
		le for bonus)				
<ul> <li>b) oral</li> <li>c) oral of</li> <li>d) projection</li> <li>e) present</li> <li>lf a write</li> <li>stead ta</li> <li>of assent</li> <li>nation</li> <li>Langua</li> </ul>	examin examin ect repo entatio ten exa ake the ssmen date at ge of a	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 min amination was chosen form of an oral examin t is changed, the lectur the latest. ssessment: German an ffered: In the semester	each (approx. 30 minus s of 2, approx. 30 minus es) or utes). as method of assessme nation of one candidate er must inform student d/or English	tes per candidate) of ent, this may be char e each or an oral exa s about this by four y	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachi	ng cycl	e				
	•					
Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
		-	• • • •			
Module	e appea	rs in				
Master's wi (2019)	ith 1 majoi	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen		page 273 / 349

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

Module title					Abbreviation	
Quantu	ım Tran	sport			11-QTH-161-m01	
Module	e coordi	nator		Module offered by		
Manag	ing Dire	ctor of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	pl. of module(s)		
6	numer	ical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
The lecture addresses the fundamental transport phenomena of electrons in nanostructures. This includes the topics of: ballistic and diffuse transport, electron interference effects, quantisation of conductivity, interaction phenomena between electrons, Coulomb blockade, thermoelectric properties, description of spin-dependent transport phenomena, topological insulators, solid-state quantum computers.						
Intende	ed learr	ning outcomes				
		nave mastered the basi cations of respective co		nostructures in theor	y and practice. They	know functi-
Course	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ger	man)		
V (3) + R (1) Module taught in: German or English						
Metho	d of ass	essment (type, scope, lang	uage — if other than German, o	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le for bonus)				
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocat	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycle	9				
Referre	ed to in	LPOI (examination regulation	ons for teaching-degree progra	mmes)		
Module	e appea	rs in				
Master Master Master	Module appears in         Master's degree (1 major) Mathematics (2016)         Master's degree (1 major) Physics (2016)         Master's degree (1 major) Nanostructure Technology (2016)         Master's degree (1 major) Computational Mathematics (2016)         Master's with 1 major Computational Mathematics         JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-         page 275 / 349					
(2019)				ECTS) Computational Mathem	101103 - 2019	

Master's degree (1 major) Functional Materials (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Functional Materials (2025)

Metho	Module title				Abbreviation	
Methods of Observational Astronomy					11-ASM-161-m01	
Module coordinator			Module offered by			
Managing Director of the Institute of Theoretical Physics and Astrophysics			neoretical Physics	Faculty of Physics a	and Astronomy	
ECTS	Metho	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	5		
1 semester graduate						
Conten	its					
		-		gnetic spectrum. Eva	luation of observational da	ta
		tical, X-ray and gamma-r	ay telescopes.			
	-	ning outcomes		• • • • • • • • • •	e electromagnetic spectru	
dio, op ability	tical, X to conc	-ray and gamma-ray ener luct astronomical observ	rgies). Knowledge of rations.	principles and applic	cations of these methods a	
	-	number of weekly contact hours,	language — if other than Ge	rman)		
V (3) + Module		t in: German or English				
			age — if other than German,	examination offered — if no	ot every semester, information on w	hether
		ele for bonus)				
b) oral	examir	mination (approx. 90 to a nation of one candidate e				
d) proje e) pres If a writ stead t of asse nation Langua	ect repo entatio tten exa ake the essmen date at age of a	e form of an oral examina	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may mination in groups. If the r weeks prior to the original	nethoo
d) proje e) pres If a writ stead t of asse nation Langua Assess	ect repo entatio tten exa ake the essmen date at age of a ment o	ort (approx. 8 to 10 pages in/talk (approx. 30 minut amination was chosen as form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester in	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may mination in groups. If the r weeks prior to the original	nethoo
d) proju e) pres If a writ stead t of asse nation Langua Assess Allocat	ect repe entatio tten exa ake the essmen date at age of a ment o <b>ion of j</b>	ort (approx. 8 to 10 pages in/talk (approx. 30 minut amination was chosen as a form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester in <b>places</b>	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may mination in groups. If the r weeks prior to the original	nethoo
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d) proju e) pres If a writ stead t of asse nation Langua Assess Allocat  Additic	ect repe entatio tten exa ake the essmen date at age of a ment o ion of p	ort (approx. 8 to 10 pages in/talk (approx. 30 minut amination was chosen as a form of an oral examina t is changed, the lecture the latest. issessment: German and ffered: In the semester in <b>places</b>	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may mination in groups. If the r weeks prior to the original	nethoo
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d) proju e) pres If a writ stead t of asse nation Langua Assess Allocat  Additic  Worklo 180 h	ect repe entatio tten exa ake the essmen date at age of a ment o ion of p onal inf	ort (approx. 8 to 10 pages in/talk (approx. 30 minut amination was chosen as a form of an oral examina t is changed, the lectures the latest. issessment: German and ffered: In the semester in places ormation	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four	nged and assessment may mination in groups. If the r weeks prior to the original	nethoo
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d) proju e) pres If a writi stead t of asse nation Langua Assess Allocat  Worklo 180 h Teachin  Referre 	ect repe entatio tten exa ake the essmen date at age of a ment o ion of p onal inf pad	e LPOI (examination regulation	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English n which the course is	ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four offered and in the su	nged and assessment may mination in groups. If the r weeks prior to the original	netho
d) proje e) pres If a writi stead t of asse nation Langua Assess Allocat  Worklo 180 h Teachin  Referre  Master Master Master	ect repo entatio tten exa ake the essmen date at age of a ment o ion of p onal inf onal inf ead ed to in e appea 's degr 's degr	e LPOI (examination regulation	of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen /or English n which the course is //or English //or Eng	ent, this may be cha e each or an oral exa ts about this by four offered and in the su offered and in the su ammes)	nged and assessment may mination in groups. If the r weeks prior to the original	netho

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

Module title				Abbreviation		
Experimental Particle Physics 11-TPE-161-m01						
Module coordinator			Module offered by			
Manag	ing Dire	ector of the Institute of	Applied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
supers as well of syste	ymmet as oth ematic		yond the standard mo	del. Determination of	f the top quark mass	and W mass
Intend	ed lear	ning outcomes				
questic	ons of F	are familiar with the pri Particle Physics, which a able to put results into	are examined by using	these detectors. The	y know modern met	
Course	<b>S</b> (type, r	umber of weekly contact hour	s, language — if other than Ge	rman)		
V (3) + Module		t in: German or English				
		sessment (type, scope, lang		examination offered — if no	t every semester, informati	ion on whether
		le for bonus)			, ,	
<ul> <li>b) oral</li> <li>c) oral</li> <li>d) projection</li> <li>e) pression</li> <li>lf a write stead t</li> <li>of assession</li> <li>Languat</li> <li>Assession</li> </ul>	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Workload						
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
Module appears in						
Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016)						
	-	Computational Mathematics	JMU Würzburg • g	enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 279 / 349

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

exchange program Physics (2023)

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

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

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

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

Module title				Abbreviation		
Introduction to Space Physics 11-ASP-161-mo1						
Module coordinator				Module offered by		
Managing Director of the Institute of Theoretical Physics and Astrophysics				Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numei	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts					
3. Elem 4. The s 5. Accel	mics o ents of un and eratior	f charged particles in m space physics I heliosphere and transport of energ to measure energetic	getic particles in the he	eliosphere		
Intende	d learr	ning outcomes		· ·		
The stu mics of	dents a charge	acquire basic knowledg ed particles in space an ding measuring metho	d the heliosphere. The			
Courses	<b>5</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (3) + F Module		t in: German or English				
Method	of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	on on whether
module is	creditab	le 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 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: In the semester in which the course is offered and in the subsequent semester						
Allocati	on of p	olaces				
Additio	nal info	ormation				
Workload						
180 h						
Teaching cycle						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module appears in						
Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 281 / 349						
Master's wit (2019)	ui i major	computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 281 / 349

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

Module title				Abbreviation		
Multi-wavelength Astronomy 11-MAS-161-mo1					11-MAS-161-m01	
Module coordinator				Module offered by		
Managi and Ast	-	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
2. Jet-ei 3. VLBI 4. High <sup>.</sup>	missior observ -energy	logy of active galactic nu n processes ations of jets v observations of jets nger signatures of jets	clei and extragalacti	c jets		
Intende	ed learr	ning outcomes				
nuclei a	and the		gain insights into a		observations of active galactic ed astrophysical question and	
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ge	rman)		
V (3) + I Module		t in: German or English				
Method	l of ass	s <b>essment</b> (type, scope, langua	ge — if other than German,	examination offered — if no	t every semester, information on whether	
module is	creditab	le for bonus)				
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocation of places						
Additional information						
Workload						
180 h						
Teaching cycle						
Referred to in LPO I (examination regulations for teaching-degree programmes)						
	a to 11					
Module appears in						
	Master's degree (1 major) Mathematics (2016)					
			()			

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

Module title				Abbreviation		
Quantum Mechanics II     11-QM2-161-m01						
Module coordinator				Module offered by		
Managing Director of the Institute of The and Astrophysics			Theoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	numer	ical grade				
Duratio	n	Module level	Other prerequisites	i		
1 semes	ster	undergraduate				
Conten	ts					
course for QM: for QM: 1. Histo 2. Singl 3. Princ 4. Spin 5. Appro 6. Appro 7. Seco 8. Poter 9. Gene 10. Can 11. Char 12. Qua	The contents of this lecture build upon and will be chosen in accordance with the topics of the Bachelor's degree course "Quantum Mechanics I". Topics might include: for QM: 1. Historical introduction 2. Single-particle states in a central potential 3. Principles of quantum mechanics 4. Spin and angular momentum 5. Approximations of energy eigenvalues 6. Approximations for time-dependent problems 7. Second quantisation 8. Potential scattering 9. General scattering theory 10. Canonical formalism 11. Charged particles in electromagnetic fields 12. Quantum theory of radiation 13. Quantum entanglement					
most of	the the		edge of advanced quai ree courses in Astrophy ly recommended.			
			s, language — if other than Ger	rman)		
V (4) + I	R (2)	t in: German or English				
Method	l of ass	essment (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informati	ion on whether
module is	creditab	le for bonus)				
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocation of places						
Additional information						
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 285 / 349

### Workload

240 h

Teaching cycle

R

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

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## Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Master's degree (1 major) Nanostructure Technology (2020)

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

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

Module title				Abbreviation		
Theory of Relativity				11-RTT-161-m01		
Module coordinator				Module offered by		
Managi and Ast		ector of the Institute of Th iics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten	ts					
<ol> <li>2. Differ</li> <li>3. Brief</li> <li>4. Elem</li> <li>5. Electron</li> <li>6. Field</li> <li>7. Stella</li> </ol>	rential Summ ents of rodyna equati ar equi	al Foundations forms ary of the special relativit differential geometry mics as an example of a ons of the fundamental s librium and other astroph n to cosmology	relativistic gauge the structure of general re			
		ning outcomes				
main to electroo to simp	pics in dynami le mod	clude modern formulatio	n on the basis of diff general relativity are and are introduced t	erential forms. Furth e emphasised. The st o basic elements of	cepts of general relativity. The ermore, the similarities between sudents learn to apply the theory cosmology.	
V (3) + F						
		t in: German or English				
		essment (type, scope, langua) le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> </ul>						
Assessment offered: In the semester in which the course is offered and in the subsequent semester <b>Allocation of places</b>						
 Additional information						
Worklo	ad					
180 h						
Teaching cycle						

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

#### Module appears in

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

Module title				Abbreviation		
Many Body Quantum Theory				11-QVTP-161-m01		
Module coordi	nator		Module offered by			
Managing Dire and Astrophys	ctor of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy		
ECTS Metho	od of grading	Only after succ. com	pl. of module(s)			
8 numer	rical grade					
Duration	Module level	Other prerequisites				
1 semester	graduate					
Contents						
thods of the G 1. Single-partic 2. Review of se 3. Perturbation 4. Perturbation 5. Landau theo 6. Supercondu 7. One-dimens	reen's functions. A possi cle Green's function econd quantisation in theory using many-part in theory for finite tempera bry of Fermi liquids activity sional systems and boso	ble outline might be: icle Green's functions atures		basis of the perturbative me-		
Intended learn	ning outcomes					
ledge enables		s of Fermi liquids (and	l bosonic systems) b	n-relativistic context. This know- beyond the one-particle picture, ne Kondo effect.		
Courses (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)			
V (4) + R (2) Module taught	t in: German or English					
Method of ass module is creditabl		ge — if other than German, e	examination offered — if no	t every semester, information on whether		
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: In the semester in which the course is offered and in the subsequent semester						
Allocation of p	laces					
Additional info	ormation					
Workload						
240 h						
·						
Teaching cycle	9					

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

#### Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title			Abbreviation			
Physics	Physics of Complex Systems 11-PKS-161-m01					
Module	coord	nator		Module offered by		
Managi and Ast	-	ctor of the Institute of Tl ics	neoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	ical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts					
<ol> <li>2. Introd</li> <li>3. Entrod</li> <li>4. Phas</li> <li>5. Unive</li> <li>6. Spin</li> </ol>	ductior py pro- e trans ersality glasse		equilibriumt t			
-	•	ing outcomes				
The stu derstan underst	dents a iding of tanding	acquire in-depth knowled f cooperative phenomen g of the concepts of entro es in different areas of p	a in complex many-pa opy, entropy producti	article systems. The r on and universality.	main focus includes	a thorough
Courses	<b>5</b> (type, n	umber of weekly contact hours,	language — if other than Gei	rman)		
V (2) + I Module		t in: German or English				
		essment (type, scope, langua	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		le for bonus)				
b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o 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 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: In the semester in which the course is offered and in the subsequent semester					
Allocati	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachin	ng cycl	9				
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	immes)		
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 291 / 349

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

Module title				Abbreviation		
Quantum Information and Quantum Computing 11-QIC-:					11-QIC-161-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	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numer	rical grade	11-QM2 or 11-TFK			
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts					
2. Quan 3. Comp 4. Entar 5. Quan 6. Quan	itum th posite s ngleme tum op itum ga	ary of classical information eory seen from the persp systems and the Schmid nt measures perations, POVMs, and the ates and quantum compo- the theory of decoheren	bective of informatior t decomposition ne theorems of Kraus uters			
-		ning outcomes				
The stud textboo main to quantur	dents a k inter pics of m com	acquire a comprehensive pretation. The learn how the lecture include basi puting arising from deco	to safely handle tens c mathematical conce herence.	or products and mul epts of quantum info	tipartite quantum sy	/stems. The
		umber of weekly contact hours, I	anguage — if other than Ger	man)		
V (3) + F Module		t in: German or English				
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	t every semester, informati	on on whether
b) oral e c) oral e d) proje e) prese If a writt stead ta of asses nation o Languag	<ul> <li>module is creditable for bonus)</li> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocati	on of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachin	ig cycl	9				
Referre	d to in	LPOI (examination regulation	s for teaching-degree progra	mmes)		
Master's wit (2019)	- aster's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- cord Master (120 ECTS) Computational Mathematics - 2019 page 293 / 349					page 293 / 349

Master's degree (1 major) Mathematics (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Nanostructure Technology (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title			Abbreviation				
Theoret	Theoretical Solid State Physics       11-TFK-161-m01						
Module	coord	inator		Module offered by			
Managi and Ast	-	ector of the Institute of T ics	heoretical Physics	Faculty of Physics a	and Astronomy		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
8	nume	rical grade					
Duratio	n	Module level	Other prerequisites	;			
1 semes	ster	graduate					
Conten	ts		·				
bus wh A possi 1 Band pologic 2 Electr ry, rand	The contents of this two-term course will depend on the choice of the lecturer, and may include parts of the syllabus which could alternatively be offered as "Quantum Many Body Physics" (11-QVTP). A possible syllabus may be: 1 Band structure (Sommerfeld theory of metals, Bloch theorem, k.p approach and effective Hamiltonians for to- pological insulators (TIs), bulk-surface correspondence, general properties of TIs) 2 Electron-electron interactions in solids (path integral method for weakly interacting fermions, mean field theo- ry, random phase approximation (RPA), density functional theory) 3 Application of mean field theory and the RPA to magnetism						
-		ning outcomes					
sics, wh cepts a sics" ar <b>Course</b> V (4) + I	nich are nd the nd "Qua s (type, n R (2)	b-semester lecture, the e addressed in classica methods of description antum Mechanics". umber of weekly contact hours t in: German or English	l textbooks, and there . The course builds up	by advance their kno oon the courses "Exp	wledge of the under	rlying con-	
Method	l of ass	essment (type, scope, langu	uage — if other than German,	examination offered — if no	ot every semester, informat	ion on whether	
b) oral e c) oral e d) proje e) prese If a writ stead ta of asse nation o 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 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: In the semester in which the course is offered and in the subsequent semester						
Allocati	ion of p	olaces					
Additional information							
Worklo	Workload						
240 h							
Teachir	ig cycl	9					
Master's wi (2019)	Master's with 1 major Computational Mathematics       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- cord Master (120 ECTS) Computational Mathematics - 2019       page 295 / 349						

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

#### Module appears in

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

Module title			Abbreviation			
Theoret	Theoretical Solid State Physics 2       11-TFK2-161-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	Metho	od of grading	Only after succ. con	pl. of module(s)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten	ts					
5. Adva Anderso 6. Unco 7. Green	A continuation of the first semester (11-TFK) might be the following syllabus: 5. Advanced topics of the theory of superconductivity (Bogoliubov-de Gennes equations, effective field theory, Anderson-Higgs description of the Meissner effect) 6. Unconventional superconductors (e.G. copper-oxide high-Tc superconductors) 7. Green's function methods and Feynman diagrammatic technique 8. The Kondo Effect (Anderson's "poor mans scaling", renormalization group)					
		ning outcomes		0 1/		
During sics, wh cepts a	the two nich are nd the	-semester lecture, the st addressed in classical t methods of description. antum Mechanics".	extbooks, and there	by advance their kno	wledge of the under	lying con-
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (4) + I Module		t in: German or English				
		<b>essment</b> (type, scope, langua; le for bonus)	ge — if other than German, o	examination offered — if no	t every semester, informatio	on on whether
b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o Langua	<ul> <li>module is creditable for bonus)</li> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocati	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
240 h						
Teachir	ig cycl	9				
Referre	d to in	<b>LPO I</b> (examination regulations	s for teaching-degree progra	mmes)		
	Referred to in LPO I (examination regulations for teaching-degree programmes)					
Master's wi	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathem		page 297 / 349

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

Module title			Abbreviation			
Field Theory in Solid State Physics       11-FTFK-161-m01						
Module	coordi	nator		Module offered by		
Managi and Ast	-	ctor of the Institute of T ics	neoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
8	numer	ical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts					
This will usually be a course on quantum many particle physics using the method of functional integration. An outline could be: 1. Coherent states and review of second quantization 2. The functional integral formalism at finite temperatures T 3. Perturbation theory at T=0 4. Order parameters and broken symmetry 5. Green's functions 6. The Landau theory of Fermi liquids						ration. An
		elopments iing outcomes				
The stu	dents a	are enabled to apply the ese methods compleme				
Courses	<b>5</b> (type, n	umber of weekly contact hours,	language — if other than Gei	man)		
V (4) + F Module		t in: German or English				
Method	l of ass	essment (type, scope, langu	age — if other than German,	examination offered — if no	t every semester, informati	on on whether
		le for bonus)				
b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o Langua	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocati	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
240 h						
Teachin	ig cycle	2				
Referre	d to in	LPO I (examination regulation	s for teaching-degree progra	mmes)		
Master's wii (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam. ECTS) Computational Mathem	-	page 299 / 349

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title				Abbreviation		
Topolo	gical O	rder			11-TOPO-161-m01	
Module	e coordi	nator		Module offered by		
Manag	ing Dire	ctor of the Institute of Ap	plied Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)		
6	numer	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
Topologically ordered phases possess no order in the conventional sense (i.e., no broken symmetry and no local order parameter). The order is instead characterized by topological quantum numbers. In the course, the general concepts will be illustrated with the study of specific examples of systems with topological order. The topics discussed may include: 1. Fractional charge and statistics in quantized Hall fluids 2. Spin charge separation in spin chains and chiral spin liquids 3. Non-Abelian statistics of fractionalized excitations 4. Majorana zero modes in p-wave superconductors 5. Topological degeneracies on higher genus surfaces (e.g., torus geometry) 6. Spinons and visons in spin liquids including Kitaev models.						
Intend	ed learr	ning outcomes				
The stu	dents a	acquire in-depth knowled	lge of topological ord	er in quantum conde	ensates.	
Course	<b>S</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)		
V (3) + Module		t in: German or English				
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information	on on whether
<ul> <li>b) oral</li> <li>c) oral</li> <li>d) proje</li> <li>e) pres</li> <li>lf a writh</li> <li>stead the of asset</li> <li>nation</li> <li>Languation</li> </ul>	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: In the semester in which the course is offered and in the subsequent semester					
Allocat	ion of p	laces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachi	ng cycle	9				
Referre	d to in	LPO I (examination regulations	s for teaching-degree progra	mmes)		
Master's w	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathem		page 301 / 349

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title				Abbreviation			
Topolo	Topology in Solid State Physics     11-TFP-161-m01						
Module	e coordi	nator		Module offered by			
Managi	ing Dire	ctor of the Institute of A	pplied Physics	Faculty of Physics a	nd Astronomy		
ECTS	Metho	d of grading	Only after succ. con	pl. of module(s)			
6	numer	ical grade					
Duratio	n	Module level	Other prerequisites				
1 seme	ster	graduate					
Conten	ts						
2. Math 3. Time 4. Hall 5. Bulk 6. Grap 7. Quar	<ol> <li>Geometric phase in quantum systems</li> <li>Mathematical basics of topology</li> <li>Time-reversal symmetry</li> <li>Hall conductance and Chern numbers</li> <li>Bulk-boundary correspondence</li> <li>Graphene (as a topological insulator)</li> <li>Quantum Spin Hall insulators</li> <li>Z2 invariants</li> </ol>						
Intende	ed learr	ing outcomes					
	ts serve	e as a basis of many res					
Course	<b>S</b> (type, n	umber of weekly contact hours,	language — if other than Ger	man)			
V (3) + Module		in: German or English					
		<b>essment</b> (type, scope, langua e for bonus)	age — if other than German, o	examination offered — if no	t every semester, informati	on on whether	
b) oral c) oral d d) proje e) prese If a writ stead ta of asse nation Langua	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>						
Allocat	ion of p	laces					
Additio	nal info	ormation					
Worklo	ad						
180 h							
Teachi	ng cycle	e					
Referre	d to in	LPO I (examination regulatior	is for teaching-degree progra	mmes)			
Master's wi (2019)	ith 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 303 / 349	

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title				Abbreviation		
Theory	Theory of Superconductivity     11-TSL-161-mo1					
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	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numei	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Content	ts					
for supe conduc man dia tuations nism. Ir	ercond tors. Ex agrams s, and nterplay	uctivity. Review of BCS th ktension of the phenome and functional integrals coupling to the electroma	eory and critical disc nological Ginzburg-L . Ward identities and agnetic field. Interpre entional/unconventi	cussion of its applica andau theory to a qu response functions. etation of the Meissne onal superconductiv	uctivity. Empirical Matthias rules bility for different types of super- antum field theory using Feyn- Goldstone modes, phase fluc- er effect using the Higgs mecha- ity. Discussion of current rese-	
Intende	ed learr	ning outcomes				
tism in superco percond reby it e develop ting cor	the cur onducti ductors especia oments nnectio	rent research context. Th ivity (BCS theory), which 5. Subsequently, it introd Illy focuses on Meissner	e first part of the lect fails when applied to uces tools of quantu effect and Higgs mec ion and analysis of (ι phases.	ture addresses conve o new material classe m field theory necess hanism. The last par un)conventional supe	and the interactions with magne- entional molecular field theory of is such as high-temperature su- sary to expand BCS theory. The- t of the lecture discusses current erconductors and their fascina-	
V (3) + F		, .	0.0			
		t in: German or English				
		s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	t every semester, information on whether	
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: In the semester in which the course is offered and in the subsequent semester <b>Allocation of places</b>						
Additio	nal inf	ormation				
	natinit					
Worklo	ad					
180 h						
100 11						

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

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# Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title Abbreviation					Abbreviation
Computational Materials Science (DFT)					11-CMS-161-m01
Module	e coord	inator		Module offered by	<u> </u>
Managi and As		ector of the Institute of Th	eoretical Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade			
Duratio	on	Module level	Other prerequisites	;	
1 seme	ster	graduate			
Conten	ts				
6. Ande 7. Dyna 8. DFT - 9. Stron Intende Aside f pool. TI constru the sof serve b me qua	erson in amical r + DMFT ngly con ed learn rom the he part uction c tware w order c antum N	icipants are introduced to of maximally localised Wa vannier90. Furthermore, t ases such as the Kondo Monte Carlo are utilised t	Kondo physics deling of solids of these topics, the st o the use of DFT softwannier functions thro the students learn ho regime. Impurity solv o solve the self cons	ware packages such ugh the projection of ow to construct many vers such as exact dia istency equations of	nds-on exercises from the CIP as VASP or Wien2k and to the f DFT results on atom orbitals with -particle solutions of AIM and ob agonalisation or continuous-ti- dynamic molecular field theory calculation of a strongly correla-
	<b>S</b> (type, n	metal oxide such as SrV( umber of weekly contact hours, l		rman)	
		t in: German or English			
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	ot every semester, information on whether
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: In the semester in which the course is offered and in the subsequent semester					
Allocat	ion of p	olaces			
Additional information					

#### Workload

240 h

Teaching cycle

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

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# Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's degree (1 major) Functional Materials (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

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

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

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

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

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

			JAROVENSIU		
Module title					Abbreviation
Confor	mal Fie	ld Theory			11-KFT-161-m01
Module	coord	inator		Module offered by	
Managi and Ast		ector of the Institute of Th sics	neoretical Physics	Faculty of Physics a	and Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	graduate			
Conten	ts				
(Ising, t scale ir variance two dim relevan on, qua edge in particul ons, for the first o. Intro point) 1. Confo ctions) 2. Conff tion and on, the 3. Centi sation, weight 4. Kac o conform <b>Intende</b> The stu comple also ac primari	ricritic ivarian e unde nension t to ma intised terms lar faul r examp t term of duction ormal t d Noeth free bo ral cha mode states, determ dents a tion of quire b ly addr	al Ising, 3-state Potts, etc ce is elevated from a glol er conformal transformati nal systems (either two s any interesting areas of co Hall states (where the bu of 1+1 dimensional CFTs) t-tolerant topological qua ple, owe their names to the of the course is: n (scale and conformal in heories in D dimensions theories in D=2 (primary the her's theorem, radial qua poson and vertex operator rge and Virasoro algebra expansions and Virasoro descendant fields and o inant and unitarity (Verm ds, minimal models in ge ning outcomes acquire practical and con "Quantum Mechanics II" pasic knowledge of critical ressed to students of The	c.) could be exactly ca bal to a local invariant ons. This, in turn, yie pace dimensions or co ondensed matter phy ulk wave function is co of the two-channel Ko antum computers invi- he fusion rules of the avariance, critical exp (conformal group, co fields and correlation antisation and Polyak s, conformal Ward ide (central charge, the S algebra, cylinder geo operator product expa a modules and null s neral).	alculated. The physic ice, which, for reaso lds a rich and fascin one time and one spa- rsics, including Abeli described in terms of ndo effect, fractiona olving non-Abelian a associated conform onents, the transver nformal algebra in 2 functions, quantum ov's theorem, time of entities) Schwarzian derivativo ometry and Casimir en insions, conformal b tates, Kac determina with the methods of prerequisite to take um field theory and fa aims to increase the	n functions for many models cal idea is that the principle of ns of consistency, amounts to in- ating mathematical structure for ace dimension). CFT has become ian and non-Abelian bosonisati- f conformal correlators, and the l topological insulators, and in anyons (Ising and Fibonacci any- nal fields.) A potential syllabus for rse Ising model at the self-dual D, constraints on correlation fun- n field theory, canonical quantisa- ordering and functional integrati- re, free fermion, (Abelian) bosoni- effect, in- and out-states, highest locks, duality and bootstrap) ant formula, non-unitarity proof,
Matter			anguago — if other than Co	(man)	
		number of weekly contact hours, l	anguage — If other than Gei	man)	
	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

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 309 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	

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#### e) presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: German and/or English

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

#### Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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

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## Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

Module	title				Abbreviation	
Confor	Conformal Field Theory 2 11-KFT2-161-m01					
Module coordinator Module offered by						
Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics						
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	graduate				
Conten	ts					
lid-on-s au-Ginz del, suj 6. Free 7. Free ons of V the toru 8. Free ral, S1/ operato Intende The stu comple also ac primari	solid m burg d berconf bosons fermior virason us, Jacc bosons Z2 orbi ors, the ed learr dents a tion of quire b ly addr ing acq	dels (critical statistical odels), correlation funct escription of minimal m formal models) s and fermions (mode es as on the torus (operato b algebra, modular grou bi theta function identi s on the torus (Lagrangis fold, Gaussian and Ask space of c=1 theories) <b>hing outcomes</b> acquire practical and co "Quantum Mechanics II asic knowledge of critic essed to students of Th uainted with a sophistic	tions of the critical Isin odels, modified Could xpansions, twist fields or implementation of the p and fermionic spin ties) an formulation of the p hin-Teller models, dua nceptional familiarity " (11-QM2) is the only cal phenomena, quant eoretical Physics and	ng model, fusion rule omb gas method and s, fermionic zero mod ne partition function, structures, Virasoro d partition function, fer ality between original with the methods of prerequisite to take um field theory and f aims to increase the	es and Verlinde algeb lits application to the des and fermion pari vacuum energies, re characters, critical Is rmionisation, orbifol l and orbifold theorie conformal field theorie part in this course, to functional integrals. ir general level of kn	bra, Land- ne Ising mo- ity) epresentati- sing model on lds in gene- es, marginal ory. As the the students The course is owledge by
		umber of weekly contact hours	, language — if other than Ge	rman)		
V (3) +						
Module	taugh	t in: German or English	_			
		e <b>ssment</b> (type, scope, langu le for bonus)	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
a) writt b) oral c) oral of d) proje e) prese If a writ stead ta of asse nation Langua Assess <b>Allocat</b>	en exar examin examin ect repo entatio ten exa ake the ssment date at ge of a ment o <b>ion of p</b>	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu mination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: German and ffered: In the semester	each (approx. 30 minu of 2, approx. 30 minu es) or ites). is method of assessm ation of one candidate er must inform student d/or English	tes per candidate) of ent, this may be char e each or an oral exa ts about this by four	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Master's wi (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 311 / 349

#### Workload

180 h

Teaching cycle

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

# Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

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

Module	title				Abbreviation
Magnetism and Spin Fluids					11-MSF-161-m01
Module coordinator				Module offered by	
Managing Director of the Institute of Theoretical Physics Factor and Astrophysics			Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Content	ts				
ladders dered s Possible 1. Princi Heisent 2. Magr 3. Valer gap) 4. Critic to-Yoko 5. Coup 6. Chira 7. Kitae 8. Kitae <b>Intende</b>	and sp ystems e topic iples of berg mo- netic or netic or al spin hama n led spi ll spin l v's tori v's hor ed learr dents of	pin liquids with topologic s or on spin liquids. s are: f magnetism. Ferromagne odels der (Holstein-Primakoff b nd solids in spin chains (f -1/2 chains (spinon excit model) in chains and ladders liquids (Abelian and poss c code model (spinon an neycomb lattice model (n <b>ning outcomes</b> develop an understanding	al orders. Depending etic and antiferromag posons and spin-wave Majumdar-Gosh and ations in the Haldane sibly non-Abelian) d vison excitations) on-Abelian statistics, g of the electronic ori	g on the lecturer, the netic exchange, supe e theory) AKLT Models, spinor e-Shastry model, hol ).	n-wave theory, spin-chains, spin focus may lie on magnetically or- er-exchange, Hubbard, t-j- and n confinement and the Haldane on excitations in the Kuramo-
paration mensio		e dimensional systems a	nd spin-liquids as ex	amples of systems w	vith a topological order in two di-
		umber of weekly contact hours, la	anguage — if other than Ger	man)	
V (3) + F Module		t in: German or English			
			ge — if other than German, e	examination offered — if no	t every semester, information on whether
a) writte b) oral e c) oral e d) proje e) prese If a writt stead ta of asses nation o Languag	en exar examin examin ect repo entatio ten exa ake the ssment date at ge of a	form of an oral examinat	ach (approx. 30 minu of 2, approx. 30 minut ) or es). method of assessme tion of one candidate must inform student 'or English	tes per candidate) or ent, this may be char e each or an oral exar s about this by four v	nged and assessment may in- nination in groups. If the method weeks prior to the original exami-
Allocati					
Additio	nal info	ormation			

# Workload

180 h

**Teaching cycle** 

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

# Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module	title				Abbreviation
Topological Quantum Physics					11-TQP-161-m01
Module	coord	nator		Module offered by	
Managing Director of the Institute of Theoretical Physics Facu and Astrophysics				Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
6	numei	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Content	ts				
ding on tors ass 1. Introc 2. Majo 3. Topo stics) 4. Integ 5. Berry 6. Time 7. Topo	the lea suming duction rana fe logical ger quan 's phas revers logical	turers emphasis, it is me only "Quantum mechani to superconductivity (in- rmions and topological s superconductors in two ntum Hall effect and Chen se and Chern invariants al symmetry and topolog insulators in 3D	eant to provide an int cs II" (11-QM2) as a p cluding BCS theory) superconductors in 1I dimensions (2D) (inc m insulators (Haldan	roduction to topolog rerequisite. The con O (Kitaev wires) luding Majorana edg	tical work in their thesis. Depen- rical superconductors and insula- tents may include: re states and non-Abelian stati- bi solitons and edge states)
		ning outcomes			
		rstanding of the topologi atter Physics at the Unive		itum Physics relevan	t to current research projects of
Courses	<b>S</b> (type, n	umber of weekly contact hours, la	anguage — if other than Ger	man)	
V (3) + F 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	creditab	le for bonus)			
b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o Langua;	examin examin ect repo entatio ten exa ake the ssment date at ge of a ment o	form of an oral examinat is changed, the lecturer the latest. ssessment: German and/ ffered: In the semester in	ach (approx. 30 minu of 2, approx. 30 minu ) or es). method of assessme tion of one candidate must inform student 'or English	tes per candidate) or ent, this may be char e each or an oral exar s about this by four v	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocati	ion of p	laces			
Additio	nal info	ormation			
Worklo	ad				
180 h					

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

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#### Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

Master's degree (1 major) Nanostructure Technology (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module cordinator         Module offered by           Managing Director of the institute of Theoretical Physics and Astrophysics         Faculty of Physics and Astronomy           ECTS         Method of grading         Only after succ. compl. of module(s)           0         numerical grade         -           Duration         Module level         Other prerequisites         -           1 Phase transitions         -         -         -           2. Neas field theory         -         -         -           3. The concept of the renormalization group (RG) Phase diagrams and fixed points         -         -           4. Perturbation-theoretical renormalization group         -         -         -           5. Low-dimensional systems         -         -         -         -           6. Conformal symmetry         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         <	Module	title				Abbreviation	
Managing Director of the Institute of Theoretical Physics       Faculty of Physics and Astronomy         ECTS       Method of grading       Only after succ. compl. of module(s)         Contents       •         Duration       Module level       Other prerequisites         1 semester       graduate       •         Contents       •       •         In Proceed of the renormalization group (RG) Phase diagrams and fixed points       •         4. Perturbation-theoretical renormalization group       •         5. Conformal systems       •         6. Conformal systems       •         10. Contrastical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory.         Courses type, number of weekly contact hore, language – if other than German.       V (3) + R (1)         Module taught in: German or English       •         Method of assessment (type, scape, language – if other than German, examination offered – if not every semester, information on whether module is oredulable foredulable for bornable for bornable of condu	Renormalization Group and Critical Phenomena       11-CRP-161-m01						
and Astrophysics CTS Method of grading Only after succ. compl. of module(s) Intervention Only after succ. compl. of module(s) Only after succ. compl. of module(s) Only after succ. compl. of module(s) I semester Onlemis I semester graduate Other prerequisites I semester I product of the renormalization group (RG) Phase diagrams and fixed points Perturbation-theoretical renormalization group (RG) Phase diagrams and fixed points Perturbation-theoretical renormalization group (RG) Phase diagrams and fixed points Onlemis Onle	Module coordinator Module offered by						
6       numerical grade          Duration       Module level       Other prerequisites         1 semester       graduate          Contents           1. Phase transitions           2. Mean field theory           3. The concept of the renormalization group (RG) Phase diagrams and fixed points          4. Perturbation-theoretical renormalization group           5. Low dimensional systems           6. Conformal symmetry           Intended learning outcomes           The students acquire profound knowledge of the principles of scale invariance and of the renormalisation groups (RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory.         Courses (type, number of weekly contact hours, language – if other than German, examination offered – if not every semester, information on whether module is conditable to bonus)         0 (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 conditable tor bonus)         0 written examination of one candidate each (aptrox, 3 o minutes) or       -         0	Managing Director of the Institute of Theoretical Physics       Faculty of Physics and Astronomy         and Astrophysics						
Duration         Module level         Other prerequisites           1 semester         graduate            Contents            1. Phase transitions            2. Mean field theory            3. The concept of the renormalization group (RG) Phase diagrams and fixed points            4. Perturbation-theoretical renormalization group            5. Low-dimensional systems            6. Conformal symmetry            Intended learning outcomes            The students acquire profound knowledge of the principles of scale invariance and of the renormalisation group (RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory.           Courses (type, number of weekly contact hours, language – if other than German)         V (3) + R (3)           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 honus)           a) written examination in groups (groups of 2, approx, 3 ominutes) or b) or al examination in groups (groups of 2, approx, 3 ominutes) per candidate) or d) project report (approx, 3 to to pages) or           b) oral examination nus do shosen as method of assessment, this may be changed and assessment may inststead take the form of an oral	ECTS	Metho	d of grading	Only after succ. con	npl. of module(s)		
1 semester       graduate	6	numer	ical grade				
Contents         1. Phase transitions         2. Mean field theory         3. The concept of the renormalization group (RG) Phase diagrams and fixed points         4. Perturbation-theoretical renormalization group         5. Low-dimensional systems         6. Conformal symmetry         Intended learning outcomes         The students acquire profound knowledge of the principles of scale invariance and of the renormalisation group         (RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory.         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, examination offered – if not every semester, information on whether module is creditable for bonus?         a) written examination (approx. 9o 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. 30 to pages) or         e) presentation/Talk (approx. 30 minutes).       flar written examination in groups, lif the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination ago assessment and/or English         Assessment Offered: In the semester in which the course is offered and in the subsequent semester	Duratio	n	Module level	Other prerequisites	;		
	1 semes	ster	graduate				
2. Mean field theory 3. The concept of the renormalization group (RG) Phase diagrams and fixed points 4. Perturbation-theoretical renormalization group 5. Low-dimensional systems 6. Conformal symmetry Intended learning outcomes The students acquire profound knowledge of the principles of scale invariance and of the renormalisation group (RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory. 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 of one candidate each (approx. 30 minutes) or c) oral examination of one candidate each (approx. 30 minutes) or c) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination may 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: In the semester in which the course is offered and in the subsequent semester Aldictional information  Morkload 180 h Teaching cycle  Referred to in LPO I (examination for teaching-degree programmes)  Module appears in Muture (approx. 30 MUW Durburg • generated 39-Apr-2025 • exam. reg. data rec Page 317/340	Content	ts					
The students acquire profound knowledge of the principles of scale invariance and of the renormalisation group (RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory. 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 borus) a) written examination (approx. 90 to 120 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination in on candidate each (approx. 30 minutes) or e) presentation/talk (approx. 30 to 120 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: In the semester in which the course is offered and in the subsequent semester Aldottional information	2. Mear 3. The c 4. Pertu 5. Low-c	n field t oncept rbatior dimens	heory of the renormalizatior n-theoretical renormali ional systems		grams and fixed poin	ts	
(RG) in Statistical Physics. They understand the concept of RG flow with respect to effective field theories in both statistical and quantum field theory. <b>Courses</b> (type, number of weekly contact hours, language — if other than German)         V (3) + R (1)         Module taught in: German or English <b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)         a) written examination (approx. 9 to 120 minutes) or         b) oral examination in groups (groups of 2, approx. 30 minutes) or         c) oral examination in groups (groups of 2, approx. 30 minutes) or         e) project report (approx. 8 to 10 pages) or         e) project report (approx. 30 minutes).         fa 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 afor English         Assessment offered: In the semester in which the course is offered and in the subsequent semester         Alditional information	Intende	d learn	ing outcomes				
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 of one candidate each (approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) or c) oral examination in groups (groups of 2, approx. 3 or minutes) per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 3 or 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: In the semester in which the course is offered and in the subsequent semester Aldotional information  Workload 180 h Teaching cycle  Referred to in LPO1 (examination for teaching-degree programmes)  Module appears in Matter's with 1 major Computational Mathematics MUW Wirzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	(RG) in	Statisti	cal Physics. They unde	• • •			
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 in groups (groups of 2, 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).         ff a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.         Language of assessment: German and/or English         Assessment offered: In the semester in which the course is offered and in the subsequent semester         Alditional information               Morkload         180 h         Teaching cycle               Referred to in LPO1 (examination regulations for teaching-degree programmes)            Module appears in	Courses	<b>5</b> (type, n	umber of weekly contact hours	s, language — if other than Ge	rman)		
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) or e) presentation/talk (approx. 30 to 120 ages) 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: In the semester in which the course is offered and in the subsequent semester Allocation of places Additional information Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in			: in: German or English				
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) 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: In the semester in which the course is offered and in the subsequent semester Allocation of places  Motitional information  Workload 180 h Teaching cycle  Meferred to in LPO I (examination regulations for teaching-degree programmes)  Maker's with 1 major Computational Mathematics MUW Wirzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	Method	of ass	<b>essment</b> (type, scope, lang	uage — if other than German,	examination offered — if no	t every semester, informat	ion on whether
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: In the semester in which the course is offered and in the subsequent semester Allocation of places  Additional information  Workload 180 h Teaching cycle  Referred to in LPO I (examination regulations for teaching-degree programmes)  Module appears in MuWürzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	module is	creditabl	e for bonus)				
Additional information Workload Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o Langua	examin examination entation ten exa ake the ssment date at ge of as	ation of one candidate ation in groups (groups ort (approx. 8 to 10 pag n/talk (approx. 30 min mination was chosen form of an oral examir is changed, the lectur the latest. ssessment: German an	each (approx. 30 minu s of 2, approx. 30 minu es) or utes). as method of assessm nation of one candidate er must inform student d/or English	ttes per candidate) of ent, this may be char e each or an oral exa ts about this by four	nged and assessmen mination in groups. weeks prior to the on	If the method riginal exami-
Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	Allocati	on of p	laces				
Workload 180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349							
180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	Additio	nal info	ormation				_
180 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349							
Teaching cycle            Referred to in LPO I (examination regulations for teaching-degree programmes)            Module appears in         Master's with 1 major Computational Mathematics       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-       page 317 / 349	Worklo	ad					
Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	180 h						
Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	Teachin	ig cycle	9				
Module appears in Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349							
Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349	Referre	d to in	LPO I (examination regulation	ons for teaching-degree progra	ammes)		
Master's with 1 major Computational Mathematics JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re- page 317 / 349							
	Module	appea	rs in				
2019) cord Master (120 ECTS) Computational Mathematics - 2019	Master's wit (2019)	th 1 major	Computational Mathematics			-	page 317 / 349

# UNIVERSITÄT WÜRZBURG

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

Module	title				Abbreviation
Bosonisation and Interactions in One Dimension				11-BWW-161-m01	
Module coordinator Module offered I					
Managing Director of the Institute of Theoretical Physics Faculty of Pland Astrophysics				Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	ıpl. of module(s)	
6	numer	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Content	ts				
2.Abelia malizati The bela 3.Intera 4.Bethe 5.Spin-1 6.Disoro	an boso ion gro ow men acting fo e ansat 1/2 cha dered s	up, and the sine-Gordon ntioned topics will be pre ermions on a lattice (Hub z ins systems	quids (spinless fermi model). esented in different yo bard model, t/J mode	ears: el, transport properti	ctions, models with spin, renor- es) ra construction, Knizhnik-Zamo-
		ation, applications of the		ly digebras, sugawar	
Intende	ed learr	ning outcomes			
					ctron systems and acquire the lisorder effects and transport in
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (3) + F Module		t in: German or English			
		<b>essment</b> (type, scope, langua; le for bonus)	ge — if other than German, $\epsilon$	examination offered — if no	t every semester, information on whether
b) oral e c) oral e d) proje e) prese If a writt stead ta of asses nation o Languas Assess Allocati	examin examin ect repo entation ten exa ake the ssment date at ge of as ment of ion of p	form of an oral examinate is changed, the lecturer the latest. ssessment: German and/ ffered: In the semester in	ach (approx. 30 minu of 2, approx. 30 minu ) or es). method of assessme tion of one candidate must inform student <sup>/</sup> or English	tes per candidate) or ent, this may be char e each or an oral exar s about this by four v	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Workloa	ad				
180 h					

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

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



Module	title				Abbreviation
Gauge Theories 11-EIT-161-m01					11-EIT-161-m01
Module coordinator Module offered by					
Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics			nd Astronomy		
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)	
6	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	graduate			
Conten	ts				
elabora A possi 1. Introd 2. Phas 3. The t 5. Ising 6. Abeli 7. The p 8. Non- <b>Intende</b> The stu apply th descrip	ting or ble out duction e trans ransfer wo-din lattice ian latt blanar H Abelian dents a nis kno tions. <b>s</b> (type, n	the role of lattice gauge line might be: to lattice gauge theories itions matrix nensional (2D) Ising mod gauge theory ice gauge theories Heisenberg (XY) model in n lattice gauge theories <b>hing outcomes</b> acquire in-depth understa	theories in spin syst for spin systems el 2D (Kosterlitz-Thoule anding of gauge field illustrating the interp	ems. ess transition) s in classical and Qu lay between microso	may be taught and illustrated by antum Physics. They are able to copic models and field-theoretic
Method	l of ass		ge — if other than German, e	examination offered — if no	t every semester, information on whether
a) writte b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation e Langua	en exar examin examin ect repo entatio ten exa ake the ssment date at ge of a	form of an oral examina	ach (approx. 30 minu of 2, approx. 30 minu ) or es). method of assessme tion of one candidate must inform student for English	tes per candidate) or ent, this may be char e each or an oral exar s about this by four v	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-
Allocati					
Additio	nal info	ormation			
Worklo	ad				
180 h					
·					

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

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# Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Module title			Abbreviatio	n
Introduction to Gauge/Gravity Duality 11-GGD-161-m			·m01	
Module coord	linator		Module offered by	
	ector of the Institute of	Theoretical Physics	Faculty of Physics and Astronom	ıy
	od of grading	Only after succ. co	mpl. of module(s)	
8 nume	rical grade			
Duration	Module level	Other prerequisite	S	
1 semester	graduate			
Contents		•		
<ul> <li>Quantis</li> <li>Interact</li> <li>Renorm</li> <li>Gauge R</li> <li>Conform</li> <li>Large N</li> <li>Supersy</li> <li>Elements o</li> <li>Manifol</li> <li>Rieman</li> <li>Maxima</li> <li>Black h</li> <li>Elements o</li> <li>Open at</li> <li>Strings</li> <li>Type IIE</li> <li>D-Brane</li> <li>Atema</li> <li>Kear-ho</li> <li>Field-op</li> <li>Tests of</li> <li>Hologra</li> <li>Hologra</li> <li>Hologra</li> <li>Hologra</li> <li>Hologra</li> <li>Hologra</li> <li>Transpor</li> <li>Application</li> <li>Finite cl</li> <li>Quantu</li> <li>Hologra</li> <li>Entangl</li> <li>Application</li> <li>Gravity</li> <li>Gravity</li> </ul>	alisation Group Fields nal Symmetry expansion ymmetry f gravity ds, coordinate covaria n curvature ally symmetric spacetir oles f string theory nd closed strings in background fields f string Theory es T correspondence ent of the correspondence for correspondence for correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence f the correspondence	nce and metric nes nce es correlation functions Conformal anomaly rries group odynamics temperature ormalism riscosity and conductive r physics sner-Nordström black		

## Intended learning outcomes

The students acquire a thorough understanding of the foundations of gauge/gravity duality and the ability to carry out basic tests. Depending on the pre-existing knowledge and interests of the students, the module addresses a selection of the aforementioned topics. Knowledge of quantum mechanics and classical electrodynamics is a prerequisite for this course. Knowledge of quantum field theory and general relativity is useful, but not a prerequisite.

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

V (4) + R (2)

Module taught in: German or English

**Method of assessment** (type, scope, language – if other than German, examination offered – if not every semester, information on whether module 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

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

Allocation of places

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#### Additional information

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Workload

240 h

**Teaching cycle** 

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

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### Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

Master's with 1 major Computational Mathematics	JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-	page 324 / 349
(2019)	cord Master (120 ECTS) Computational Mathematics - 2019	



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

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

Module title Abbreviation				Abbreviation	
Introdu	Introduction to Fractional Quantisation 11-EFQ-161-m01				
Module	coordi	nator		Module offered by	
Managi and Ast		ctor of the Institute of Th ics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
6	6 numerical grade				
Duratio	n	Module level	Other prerequisites		
1 semes	1 semester graduate				
Contents					
The cou followir		l elaborate on instances	of fractional quantisa	ation in nature, most	ly employing examples from the
<ol> <li>Midgap states in polyacethylene</li> <li>Abelian quantised Hall states (Laughlin states, fractional charge and statistics, hierarchy states, effective Chern-Simons theory)</li> <li>Non-Abelian quantised Hall states (Pfaffian states, Majorana fermions, non-Abelian statistics, Read-Rezayi states)</li> <li>Spin chains (Haldane-Shastry model, spinon excitations, holon excitations in the Kuramoto-Yokoyama model, Yangian symmetry)</li> <li>Chiral spin liquids (Abelian and non-Abelian) 6. Kitaev models (toric code model, honeycomb model).</li> </ol>					
Intende	ed learr	ning outcomes			
	orincipl	e of "More is different" b			ms and with Anderson's philoso- condensates exhibiting fractio-
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	man)	
V (3) + I Module		t in: German or English			
		<b>essment</b> (type, scope, langua le for bonus)	ge — if other than German, e	examination offered — if no	t every semester, information on whether
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: In the semester in which the course is offered and in the subsequent semester					
Allocati	ion of p	laces			
Additio	nal info	ormation			
Worklo	ad				
180 h					

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

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## Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Module title					Abbreviation	
Τοροίο	<b>Topological Effects in Electronic Systems</b> 11-TEF-161-m01					
Module	coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of sics	Theoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Conten			<b>]</b>			
The continuous development of the field of topological phases including topological insulators, superconduc- tors, and spin liquids requires a continuous adaptation of the graduate curriculum. The course aims to deepen the students understanding of concepts related to contemporary research and/or to keep up with contemporary developments. The specific choice of topics will vary with the lecturers from year to year.						
· · · · · ·		ning outcomes				
		ers the opportunity to of Würzburg.	get acquainted with top	pics of immediate rel	evance to research o	conducted at
Courses	<b>5</b> (type, n	umber of weekly contact hour	s, language — if other than Ge	rman)		
V (3) + F Module		t in: German or English				
Method	l of ass	essment (type, scope, lang	guage — 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 e) prese If a writ stead ta of asses nation o	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> </ul>					If the method riginal exami-
Allocati	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachin	ig cycl	2				
	0 . )	-				
Referre	d to in	LPOI (examination regulation	ons for teaching-degree progra	ummes)		
Module	appea	in in				
Master' Master'	s degre s degre	ee (1 major) Mathemat ee (1 major) Physics (2 ee (1 major) Mathemat	016)			
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathen	-	page 328 / 349
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#### Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	title				Abbreviation	
Field Th	eoreti	cal Aspects of Solid Stat	e Physics		11-FTAS-161-m01	
Module	coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of T ics	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	Iration Module level Other prerequisites					
1 semes	ster	graduate				
Conten	ts					
The topics of the course will vary from year to year and may include the description of superconductors through classical field theory (the Higgs mechanism), non-linear sigma models for spin chains, Chern-Simons and axion theories as effective descriptions of quantised Hall fluids and topological insulators, respectively, or the SU(2) level k Wess-Zumino-Witten model as an example of a conformal field theory with a symmetry group (or algebra) beyond the Virasoro algebra.						
Intende	ed learn	ning outcomes				
		acquire an in-depth und of Condensed Matter Pl		n field theory and its	fundamental impor	tance for al-
Courses	<b>5</b> (type, n	umber of weekly contact hours,	language — if other than Ge	rman)		
V (3) + F Module		t in: German or English				
Method	l of ass	s <b>essment</b> (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 e) prese If a writ stead ta of asses nation o Langua	examin examin ect repo entatio ten exa ake the ssment date at ge of a	nination (approx. 90 to ation of one candidate e ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: German and ffered: In the semester i	each (approx. 30 minu of 2, approx. 30 minu s) or tes). s method of assessme ation of one candidate r must inform student //or English	tes per candidate) of ent, this may be char e each or an oral exact s about this by four y	nged and assessmer mination in groups. weeks prior to the or	If the method riginal exami-
Allocati	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachin	ng cycl	e				
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	ammes)		
Module						
	-	ee (1 major) Mathematic ee (1 major) Physics (201				
	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam	-	page 330 / 349
(2019)			cord Master (120	ECTS) Computational Mather	natics - 2019	

#### Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019)

Module	title				Abbreviation	
Cosmol	ogy				11-AKM-161-m01	
Module	coord	nator		Module offered by		
Managi and Ast	-	ctor of the Institute of T ics	heoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)		
6	numer	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Contents						
Expanding space-time, Friedmannian cosmology, basics of general relativity, the early universe, inflation, dark matter, primordial nucleosynthesis, cosmic microwave background, structure formation, galaxies and galaxy clu- sters, intergalactic medium, cosmological parameters.						
Intende	d learr	ning outcomes				
	ate the	nave basic knowledge o m to observations. They tions.				
Courses	<b>5</b> (type, n	umber of weekly contact hours,	language — if other than Ger	rman)		
V (3) + F Module	• •	t in: German or English				
		<b>essment</b> (type, scope, langu le for bonus)	age — if other than German, o	examination offered — if no	t every semester, informati	on on whether
b) oral e c) oral e d) proje e) prese lf a writ stead ta of asses nation o	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> </ul>					If the method
Allocati			_		•	
	•					
Additio	nal info	ormation				
Worklo	ad					
180 h						
Teachin	g cycle	9				
	<u> </u>					
Referre	d to in	LPO I (examination regulation	ns for teaching-degree progra	immes)		
				-		
Module	appea	rs in				
Master' Master'	s degre s degre	ee (1 major) Mathematic ee (1 major) Physics (20 ee (1 major) Mathematic	16)			
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam. ECTS) Computational Mathem	-	page 332 / 349

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

Module title				Abbreviation							
Theoretical Astrophysics					11-AST-161-m01						
Module coordinator Module offer				Module offered by	<u> </u>						
			Theoretical Dhysics	-	and Actronomy						
and Ast		ector of the Institute of sics		Faculty of Physics a	ind Astronomy						
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)							
6	nume	rical grade									
Duratio	on	Module level	Other prerequisites	i							
1 seme	ster	graduate									
Conten	ts										
			ich as e.g. white dwarfs liation transport, and g		olack holes, superno	ovae, pulsars,					
		ning outcomes									
			nethods of Theoretical /	Astrophysics. Ability	to formulate theore	tical models.					
			rs, language — if other than Ge								
V (2) +											
		t in: German or Englisł	1								
			guage — if other than German,	examination offered — if no	ot every semester. informat	tion on whether					
		le for bonus)	guage in other than definant,								
stead ta of asse nation Langua	ake the ssmen date at ge of a ment o	e form of an oral exami t is changed, the lectu the latest. ssessment: German a ffered: In the semeste	as method of assessm nation of one candidate rer must inform studen nd/or English r in which the course is	e each or an oral exa ts about this by four	mination in groups. weeks prior to the o	If the method riginal exami-					
Additio	nal inf	ormation									
Worklo	ad										
180 h											
Teachi	ng cycl	e									
Referre	d to in	LPO I (examination regulat	ions for teaching-degree progra	ammes)		Referred to in LPO I (examination regulations for teaching-degree programmes)					
Module	e appea	urs in									
Master Master Master Master Master	's degr 's degr 's degr 's degr 's teacl	ee (1 major) Mathemat ee (1 major) Physics (2 ee (1 major) Mathemat ee (1 major) Computat ning degree Gymnasiu	016) ical Physics (2016) ional Mathematics (201 m MINT Teacher Educat	ion PLUS, Elite Netw		016)					
Master Master Master Master Master Supple	's degro 's degro 's degro 's degro 's teach mentai	ee (1 major) Mathemat ee (1 major) Physics (2 ee (1 major) Mathemat ee (1 major) Computat ning degree Gymnasiu	016) ical Physics (2016) ional Mathematics (201 m MINT Teacher Educat r Education PLUS, Elite	ion PLUS, Elite Netw	B) (2016)	016)					

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

Module title					Abbreviation	
High Er	nergy A	strophysics			11-APL-161-m01	
Module	e coord	inator		Module offered by		
Managi and Ast	-	ector of the Institute of sics	Theoretical Physics	Faculty of Physics a	and Astronomy	
ECTS	Meth	od of grading	Only after succ. cor	npl. of module(s)		
6	nume	rical grade				
Duratio	on	Module level	Other prerequisites	;		
1 seme	ster	graduate				
Conten	ts	κ				
		cesses, interaction of li production, astrophysic			sses, pair creation,	nuclear pro-
Intende	ed lear	ning outcomes				
		ains knowledge in func adiative processes in a		gy Astrophysics, suc	h as particle accele	ration and
Course	<b>S</b> (type, r	number of weekly contact hour	s, language — if other than Ge	rman)		
V (3) + Module		t in: German or English				
		s <b>essment</b> (type, scope, lang ble for bonus)	guage — if other than German,	examination offered — if no	ot every semester, informat	tion on whether
If a writ stead ta of asse nation Langua	tten exa ake the ssmen date at ge of a	n/talk (approx. 30 min amination was chosen e form of an oral examin t is changed, the lectur t the latest. Issessment: German ar offered: In the semester	as method of assessm nation of one candidate rer must inform studen nd/or English	e each or an oral exa ts about this by four	mination in groups. weeks prior to the o	If the method riginal exami
Allocat						
Additio	onal inf	ormation				
Worklo	ad					
180 h		•				
Teachin	πα τητι	e				
Teachii	ing LyLl	e				
		e LPO I (examination regulati	ons for teaching-degree progra	ammes)		
	ed to in	LPOI (examination regulati	ons for teaching-degree progra	ammes)		
 Referre  Module Master	ed to in e appea	LPOI (examination regulati ars in ee (1 major) Mathemati	ics (2016)	ammes)		
 Referre  Module Master Master	<b>ed to in</b> <b>e appea</b> 's degr 's degr	LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Physics (20	ics (2016) 016)	ammes)		
 Referre  Module Master Master Master	<b>ed to in</b> <b>e appea</b> 's degr 's degr 's degr	LPOI (examination regulati ars in ee (1 major) Mathemati ee (1 major) Physics (20 ee (1 major) Mathemati	ics (2016) 016) ical Physics (2016)			
 Referre  Module Master Master Master Master	ed to in e appea 's degr 's degr 's degr 's degr	LPO I (examination regulati ars in ee (1 major) Mathemati ee (1 major) Physics (2 ee (1 major) Mathemati ee (1 major) Computati	ics (2016) 016) ical Physics (2016) onal Mathematics (201	.6)	ork Bayaria (FNR) (2	016)
 Referre  Master Master Master Master Master	ed to in e appea 's degr 's degr 's degr 's degr 's teac	LPOI (examination regulati ars in ee (1 major) Mathemati ee (1 major) Physics (20 ee (1 major) Mathemati	ics (2016) 016) ical Physics (2016) onal Mathematics (201 n MINT Teacher Educat	.6)		016) page 336 / 349

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

Module	title				Abbreviation
Relativi	istic Qı	uantum Field Theory			11-RQFT-161-m01
Module	coord	inator		Module offered by	
Managi and Ast	•	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
8	nume	rical grade			
Duratio	n	Module level	Other prerequisites	i	
1 seme	ster	graduate			
Contents					
<ol> <li>Symmetries</li> <li>Relativistic single-particle states</li> <li>Lagrange formalism for fields</li> <li>Field quantisation</li> <li>Scattering theory and S-matrix</li> <li>Gauge principle and interaction</li> <li>Perturbation theory</li> <li>Feynman rules</li> <li>Quantum electrodynamic processes in Born approximation</li> <li>Radiative corrections</li> <li>Renormalisation (optional)</li> <li>Intended learning outcomes</li> <li>The students have mastered the principles and underlying mathematics of relativistic quantum field theories. They know how to use perturbation theory and how to apply Feynman rules. They are able to calculate basics</li> </ol>					
standin	g of ra	diative corrections and re	enormalisation.	-	over, they have a basic under-
V (4) +	R (2)	umber of weekly contact hours, l t in: German or English	anguage — ir other than Ge	innan)	
		s <b>essment</b> (type, scope, langua le for bonus)	ge — if other than German,	examination offered — if no	t every semester, information on whether
b) oral e c) oral e d) proje e) prese lf 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 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: In the semester in which the course is offered and in the subsequent semester				
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
240 h					

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

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## Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

Module title Abbreviation						
Quantu	Quantum Field Theory II 11-QFT2-161-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)		
8	nume	rical grade				
Duratio	n	Module level	Other prerequisites	i		
1 seme	ster	graduate				
Conten	Contents					
<ol> <li>Generating Functionals</li> <li>Path Integrals</li> <li>Renormalization</li> <li>Renormalization group</li> <li>Gauge theories</li> <li>Spontaneous Symmetry Breaking</li> <li>Effective Field Theory (optional)</li> </ol>						
		ning outcomes				
The stu red the	dents l princip	nave advanced knowled ples, especially of renor tum field theory by usir	malisation and gauge	theories. They are at		
Courses	<b>S</b> (type, n	umber of weekly contact hours	, language — if other than Ge	rman)		
V (4) + I Module		t in: German or English				
		e <b>essment</b> (type, scope, langu le for bonus)	age — if other than German,	examination offered — if no	t every semester, informat	ion on whether
b) oral e c) oral e d) proje e) prese If a writ stead ta of asse nation e Langua Assessi	examin examin ect repo entatio ten exa ake the ssmen date at ge of a ment o	nination (approx. 90 to ation of one candidate ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: German and ffered: In the semester	each (approx. 30 minu of 2, approx. 30 minu es) or ites). is method of assessm ation of one candidate er must inform student d/or English	tes per candidate) of ent, this may be char e each or an oral exact ts about this by four	nged and assessmen mination in groups. weeks prior to the or	If the method riginal exami-
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
240 h						
Teachir	ng cycl	9				
Referre	d to in	LPOI (examination regulatio	ns for teaching-degree progra	ammes)		
Master's wi (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mathem	-	page 340 / 349

#### Module appears in

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

Module title Abbreviation				Abbreviation
Theoretical E	lementary Particle Physic	11-TEP-161-m01		
Module coord	linator		Module offered by	
Managing Dir and Astrophy	ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy
ECTS Meth	od of grading	Only after succ. com	pl. of module(s)	
8 nume	erical grade			
Duration	Module level	Other prerequisites		
1 semester	graduate			
Contents				
<ol> <li>Fundamental particles and forces</li> <li>Symmetries and groups</li> <li>Quark model of hadrons</li> <li>Quark parton model and deep inelastic scattering</li> <li>Principles of quantum field theory</li> <li>Gauge theories</li> <li>Spontaneous symmetry breaking</li> <li>Electroweak standard model</li> <li>Quantum chrome dynamics</li> <li>Extensions of the standard model.</li> </ol>				
Intended lear	ning outcomes			
structure of the lation method	ne standard model based	on symmetry princip mple problems and p	les and experimenta processes of Element	Physics. They understand the l observations. They know calcu- ary Particle Physics. Furthermo- ded theories.
Courses (type,	number of weekly contact hours, la	anguage — if other than Ger	man)	
V (4) + R (2) Module taugh	nt in: German or English			
Method of as module is credital		ge — if other than German, e	examination offered — if no	t every semester, information on whether
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: In the semester in which the course is offered and in the subsequent semester				
Allocation of	places			
Additional in	formation			
Workload				
240 h				

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

exchange program Physics (2023)

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

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

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

Module	title				Abbreviation	
Selected Topics of Theoretical Elementary Particle Physics					11-ATTP-161-m01	
Module	coord	inator		Module offered by		
Managi and Ast		ector of the Institute of Th sics	eoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	od of grading	Only after succ. com	npl. of module(s)		
6	nume	rical grade				
Duratio	n	Module level	vel Other prerequisites			
1 semes	ster	graduate				
Contents						
<ul> <li>A selection of topics from the following fields will be covered in different years:</li> <li>1. Advanced techniques for precision calculations of scattering amplitudes</li> <li>2. Phenomenology of particle accelerators</li> <li>3. Higgs physics</li> <li>4. Top quark physics</li> </ul>						
Intende	d learı	ning outcomes				
neutrin	o phys		ulate extensions of t	he standard model. I	cle Physics, Higgs physics and Furthermore, they know how to cosmology.	
Courses	<b>5</b> (type, n	umber of weekly contact hours, l	anguage — if other than Ger	rman)		
V (3) + I Module		t in: German or English				
Method	l of ass	<b>essment</b> (type, scope, langua	ge — if other than German, e	examination offered — if no	t every semester, information on whether	
		le for bonus)				
b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation o Langua Assessi	examin examin ect repo entatio ten exa ake the ssmen date at ge of a ment o	form of an oral examinat t is changed, the lecturer the latest. ssessment: German and/ ffered: In the semester in	ach (approx. 30 minu of 2, approx. 30 minu ) or es). method of assessme tion of one candidate must inform student <sup>/</sup> or English	tes per candidate) of ent, this may be char e each or an oral exa is about this by four	nged and assessment may in- mination in groups. If the method weeks prior to the original exami-	
Allocati	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
180 h						
Teachir	ig cycl	e				
Referre	d to in	LPOI (examination regulations	s for teaching-degree progra	mmes)		
Module						
Master'	s degr	ee (1 major) Mathematics	(2016)			

Master's degree (1 major) Physics (2016) Master's degree (1 major) Mathematical Physics (2016) Master's degree (1 major) Computational Mathematics (2016) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016) Master's degree (1 major) Computational Mathematics (2019) Master's degree (1 major) Mathematics (2019) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Mathematical Physics (2020) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Mathematical Physics (2022) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)

Module title			Abbreviation			
Models	Beyon	d the Standard Model	of Elementary Particle	Physics	11-BSM-161-m01	
Module	coord	nator		Module offered by		
Managi and Ast	-	ctor of the Institute of ics	Theoretical Physics	Faculty of Physics a	nd Astronomy	
ECTS	Metho	d of grading	Only after succ. con	pl. of module(s)		
6	numer	ical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	graduate				
Contents						
2. Tests 3. Neutr	<ol> <li>Principles of the standard model of Elementary Particle Physics</li> <li>Tests of the standard model in low energy experiments and at high energy colliders</li> <li>Neutrino physics</li> <li>Higgs physics.</li> </ol>					
<ul> <li>Pl</li> <li>pa</li> <li>ex</li> <li>m</li> <li>st</li> <li>m</li> </ul>	<ul> <li>particle cosmology,</li> <li>extended gauge theories,</li> <li>models with extended Higgs sectors,</li> </ul>					
		ing outcomes				
neutrin	o physi	are familiar with the tes cs. They are able to for ensions in low energy e	mulate extensions of t	he standard model. I	Furthermore, they kr	
Courses	<b>5</b> (type, n	umber of weekly contact hours	s, language — if other than Ger	rman)		
V (3) + F Module		: in: German or English				
		<b>essment</b> (type, scope, lang e for bonus)	uage — if other than German, o	examination offered — if no	t every semester, informat	on on whether
b) oral e c) oral e d) proje e) prese If a writt stead ta of asses nation o Languag	<ul> <li>a) written examination (approx. 90 to 120 minutes) or</li> <li>b) oral examination of one candidate each (approx. 30 minutes) or</li> <li>c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or</li> <li>d) project report (approx. 8 to 10 pages) or</li> <li>e) presentation/talk (approx. 30 minutes).</li> <li>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.</li> <li>Language of assessment: German and/or English</li> <li>Assessment offered: In the semester in which the course is offered and in the subsequent semester</li> </ul>					
Allocati	on of p	laces				
Additio	nal info	ormation				
Workloa	ad					
180 h						
Master's wit (2019)	th 1 major	Computational Mathematics		enerated 19-Apr-2025 • exam ECTS) Computational Mather	-	page 346 / 349

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

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Module appears in

Master's degree (1 major) Mathematics (2016)

Master's degree (1 major) Physics (2016)

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

Master's degree (1 major) Computational Mathematics (2016)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)

Master's degree (1 major) Mathematics (2019)

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

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

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

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

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

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

Master's degree (1 major) Mathematical Physics (2022)

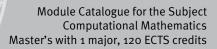
exchange program Physics (2023)

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

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

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





# **Thesis** (30 ECTS credits)

Module title Abbreviation					Abbreviation
Maste	r Thesis	s Computational Mathem	atics		10-M=MACM-161-m01
Modul	e coord	inator		Module offered by	
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS Method of grading Only after succ. compl. of module(s)					
30	nume	rical grade		· · · · · ·	
Duration Module level Other prerequisites					
1 seme	semester graduate The supervisor may make the successful completion of certain modu- les that are relevant for the respective topic a prerequisite for the assi ment of the topic.				
Conter	nts				
Indepe	endentl	y researching and writing	on a topic in mathen	natics selected in co	nsultation with the supervisor.
Intend	ed lear	ning outcomes			
tained		his/her studies in the ma			pply the skills and methods ob- the result of his/her work in a
Course	<b>es</b> (type, i	number of weekly contact hours, I	anguage — if other than Ger	rman)	
Νο cou	urses as	signed to module			
		s <b>essment</b> (type, scope, langua ole for bonus)	ge — if other than German, o	examination offered — if no	ot every semester, information on whether
Regist	ration a	is (750 to 900 hours tota nd assignment of topic ir ssessment: German or E	n consultation with su	ipervisor.	
Alloca	tion of	places			
Additio	onal inf	ormation			
Time to	o comp	lete: 6 months			
Worklo	oad				
900 h					
	ing cycl	e			
Referre	ed to in	LPO I (examination regulation	s for teaching-degree progra	mmes)	
Modul	e appea	ars in			
		ee (1 major) Computatior	al Mathematics (201	6)	
	-	ee (1 major) Computatior			
Master	r's degr	ee (1 major) Computatior	al Mathematics (202	2)	
Master	r's degr	ee (1 major) Computatior	al Mathematics (202	4)	