Module Catalogue

for the Subject

Mathematics

as a Master's with 1 major

with the degree "Master of Science"

(120 ECTS credits)

Examination regulations version: 2022
Responsible: Faculty of Mathematics and Computer Science
Responsible: Institute of Mathematics

Contents

The subject is divided into 6
Learning Outcomes 7
Abbreviations used, Conventions, Notes, In accordance with 9
Compulsory Electives 10
Subfield Mathematics 11
Applied Analysis 12
Topics in Algebra 14
Differential Geometry 16
Complex Analysis 18
Geometric Structures 20
Industrial Statistics 1 22
Lie Theory 24
Numeric of Large Systems of Equations 26
Basics in Optimization 28
Control Theory 30
Stochastic Models of Risk Management 32
Stochastical Processes 34
Topology 36
Insurance Mathematics 1 38
Time Series Analysis 40
Number Theory 42
Giovanni Prodi Lecture (Master) 44
Selected Topics in Analysis 46
Algebraic Topology 48
Selected Topics in Financial Mathematics 50
Groups and their Representations 52
Geometrical Mechanics 54
Industrial Statistics 2 56
Field Arithmetics 58
Numeric of Partial Differential Equations 60
Selected Topics in Optimization 62
Mathematical Statistics 64
Insurance Mathematics 2 66
Discrete Mathematics 68
Dynamical Systems 70
Aspects of Geometry 72
Mathematical Continuum Mechanics 74
Mathematical Imaging 76
Selected Topics in Mathematical Physics 78
Selected Topics in Control Theory 80
Inverse Problems 1 82
Module Theory 84
Non-linear Analysis 86
Optimal Control 88
Networked Systems 90
Complex Geometry 92
Partial Differential Equations of Mathematical Physics 94
Pseudo Riemannian and Riemannian Geometry 96
Functional Analysis 98
Applied Differential Geometry 100
Giovanni Prodi Lecture Selected Topics (Master) 102
Giovanni Prodi Lecture Advanced Topics (Master) 104
Giovanni Prodi Lecture Modern Topics (Master) 106

Analysis and Geometry of Classical Systems 108
Algebra and Dynamics of Quantum Systems 110
Geometric Complex Analysis 112
Selected Topics in Numerical and Applied Mathematics 114
Cryptography/Coding Theory 116
Computer Algebra 118
Algorithmic Number Theory 120
Algebraic Geometry 122
Analytic Number Theory 124
Inverse Problems 2 126
Selected Topics in Complex Analysis 128
Subfield Research in Groups and Seminars 130
Research in Groups - Algebra 131
Research in Groups - Discrete Mathematics 133
Research in Groups - Dynamical Systems and Control Theory 135
Research in Groups - Complex Analysis 137
Research in Groups - Geometry and Topology 139
Research in Groups - Mathematics in Context 141
Research in Groups - Mathematics in the Sciences 143
Research in Groups - Measure and Integral 145
Research in Groups - Numerical Mathematics and Applied Analysis 147
Research in Groups - Robotics, Optimization and Control Theory 149
Research in Groups - Time Series Analysis 151
Research in Groups - Statistics 153
Research in Groups - Number Theory 155
Research in Groups - Control Theory of Quantum Mechanical Systems 157
Research in Groups - Differential Geometry 158
Research in Groups - Deformation Quantization 160
Research in Groups - Non-linear Analysis 162
Research in Groups - Operator Algebras 164
Seminar in Applied Differential Geometry 166
Seminar in Algebra 168
Seminar in Dynamical Systems and Control 170
Seminar in Complex Analysis 172
Seminar in Financial and Insurance Mathematics 174
Seminar in Geometry and Topology 176
Giovanni Prodi Seminar (Master) 178
Interdisciplinary Seminar 180
Seminar Mathematics in the Sciences 182
Seminar in Numerical Mathematics and Applied Analysis 184
Seminar in Optimization 186
Seminar in Statistics 188
Seminar in Non-linear Analysis 190
Seminar Applied Mathematics 192
Research in Groups - Lie Theory 194
Research in Groups - Applied Differential Geometry 196
Research in Groups - Mathematical Physics 198
Research in Groups - Higher Structures 200
Research in Groups - Functional Analysis 201
Research in Groups - Inverse Problems 202
Subfield Learning and Teaching 204
Learning by Teaching 1 205
Learning by Teaching 2 206
Subfield Optional Application Subject and/or Intership 207
Application Subject Biology 208
Bioinformatics 209

Bioinformatics F1 211
Bioinformatics F2 213
Bioinformatics B 215
Systems Biology 217
Systems Biology F1 219
Systems Biology F2 221
Systems Biology B 223
Application Subject Chemie 225
Laser Spectroscopy 226
Advanced Physical Chemistry (Lab) 228
Statistical Mechanics and Reaction Dynamics 230
Nanoscale Materials 232
Ultrafast spectroscopy and quantum-control 234
Physical Chemistry of Supramolecular Assemblies 236
Physical Chemistry (Advanced Lab) 238
Basics and Applications of Quantum Chemistry 240
Numerical Methods and Programming 242
Quantum Dynamics 244
Selected Topics in Theoretical Chemistry 246
Theoretical Chemistry - Project course quantum chemistry 248
Theoretical Chemistry - Project course quantum dynamics 250
Application Subject Computer Science and Aerospace Computer Science 252
Seminar 1 - Current Topics in Computer Science 253
Advanced Programming 254
Advanced Automation 256
Algorithms for Geographic Information Systems 258
Computational Geometry 259
Approximation Algorithms 261
Automata Theory 263
Avionics Systems 265
Multimodal User Interfaces 267
Computability Theory 269
Bioinformatics 271
Introduction to Bioinformatics 273
Compiler Construction 274
Deductive Databases 276
E-Learning 278
Embedded Systems 279
Analysis and Design of Programs 281
Information Retrieval 283
3D User Interfaces 285
Computational Complexity II 287
Artificial Intelligence 1 288
Artificial Intelligence 2 290
Performance Evaluation of Distributed Systems 292
Mathematical Logic 294
Medical Informatics 296
Performance Engineering and Benchmarking of Computer Systems 298
Computer Arithmetic 299
Robotics 1 301
Robotics 2 303
Discrete Event Simulation 304
Principles of Interactive Systems 305
Software Architecture 307
Machine Learning (for User Interfaces) 309
Visualization of Graphs 311
Selected Topics in Algorithms 313

Selected Topics in Theory 315
Security of Software Systems 317
Machine Learning for Natural Language Processing 319
Professional Project Management 321
Project - Current Topics in Computer Science 323
NLP and Text Mining 325
Statistical Network Analysis 327
Application Subject Physik 329
Image and Signal Processing in Physics 330
Physics of Advanced Materials 332
Spintronics 334
Solid State Spectrocopy 336
Magnetism 338
Optical Properties of Semiconductor Nanostructures 340
Methods of Observational Astronomy 342
Experimental Particle Physics 344
Introduction to Space Physics 346
Multi-wavelength Astronomy 348
Quantum Mechanics II 350
Theory of Relativity 352
Physics of Complex Systems 354
Theoretical Solid State Physics 356
Theoretical Solid State Physics 2 358
Computational Materials Science (DFT) 360
Conformal Field Theory 362
Conformal Field Theory 2 364
Renormalization Group and Critical Phenomena 366
Bosonisation and Interactions in One Dimension 368
Introduction to Gauge/Gravity Duality 370
Cosmology 373
Theoretical Astrophysics 375
High Energy Astrophysics 377
Quantum Field Theory II 379
Theoretical Elementary Particle Physics 381
Selected Topics of Theoretical Elementary Particle Physics 383
Models Beyond the Standard Model of Elementary Particle Physics 385
Solid State Physics 2 387
Semiconductor Physics 389
Field Theory in Solid State Physics 391
Advanced Theory of Quantum Computing and Quantum Information 393
Topological Effects in Solid State Physics 395
Phenomenology and Theory of Superconductivity 397
Quantum Field Theory I 399
Internship 401
Internship Mathematics 402
Thesis 403
Master Thesis Mathematics 404

The subject is divided into

section / sub-section	ECTS credits	starting page
Compulsory Electives	90	10
Subfield Mathematics	30	11
Subfield Research in Groups and Seminars	10	130
Subfield Learning and Teaching		204
Subfield Optional Application Subject and/or Intership		207
Application Subject Biology		208
Application Subject Chemie		225
Application Subject Computer Science and Aerospace Computer Science		252
Application Subject Physik		329
Internship		401
Thesis	30	403

Learning Outcomes

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 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 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 anderer Fächer in denen mathematische Methoden zum Einsatz kommen.

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.
- 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.

Abbreviations used

Course types: **E** = field trip, **K** = colloquium, **O** = conversatorium, **P** = placement/lab course, **R** = project, **S** = seminar, **T** = tutorial, **Ü** = exercise, **V** = lecture

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

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

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

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

Conventions

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

Notes

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

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

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

In accordance with

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

ASPO2015

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

02-Feb-2022 (2022-5)

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 Mathematics

(30 ECTS credits)

Module title	Abbreviation
Applied Analysis	10-M=AAAN-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

In-depth study of functional analysis and operator theory, Sobolev spaces and partial differential equations, theory of Hilbert spaces and Fourier analysis, spectral theory and quantum mechanics, numerical methods (in particular FEM methods), principles of functional analysis, function spaces, embedding theorems, compactness, theory of elliptic, parabolic and hyperbolic partial differential equations with methods from functional analysis.

Recommended previous knowledge:
Familiarity with the contents of the module "Functional Analysis" is strongly recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results of higher analysis. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics and other natural and engineering sciences.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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)

Module title			Abbreviation
Topics in Algebra			10-M=AALG-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Contemporary topics in algebra, for example coding theory, elliptic curves, algebraic combinatorics or computer algebra.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in a contemporary field of algebra, and is able to apply these skills to complex questions.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Differential Geometry	10-M=ADGM-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Central and advanced results in differential geometry, in particular about differentiable and Riemannian manifolds.

Recommended previous knowledge:
Basic knowledge from the modules "Introduction to Differential Geometry", "Introduction to Topology" and "Geometric Analysis" is recommended.

Intended learning outcomes

The student is acquainted with concepts and methods for differentiable manifolds or Riemannian manifolds, is able to apply these methods and knows about the interaction of local and global methods in differential geometry.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

--

Workload

300 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 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
Complex Analysis			10-M=AFTH-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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 functions (e. g. elliptic functions).

Recommended previous knowledge:
Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results of higher complex analysis, in particular the (geometric) mapping properties of holomorphic functions. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Geometric Structures	10-M=AGMS-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Tits buildings, generalised polygons or related geometric structures, automorphisms, BN pairs in groups, Moufang conditions, classification results.

Recommended previous knowledge:
Basic knowledge from the modules "Introduction to Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions, methods and results concerning a type of geometric structure. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Industrial Statistics 1			10-M=AIST-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Theory of parameter and domain estimates, tests for statistical estimates, distribution models, empirical distribution analysis, comparative analysis, statistical product testing, survey sampling, audit sampling.

Intended learning outcomes

The student masters the fundamental statistical methods for industrial applications.

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

V (4) + Ü (2)
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. 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

Allocation of places

--

Additional information

--

Workload

300 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) 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)
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
Lie Theory	10-M=ALTH-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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 recommended. Furthermore, basic knowledge of the contents of the module "Introduction to Differential Geometry" is useful.

Intended learning outcomes

The student is acquainted with the fundamental results, theorems and methods in Lie theory. He/She is able to apply these to common problems, and knows about the interactions of group theory, analysis, topology and linear algebra.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Discretisation of elliptic differential equations, classical iteration methods, preconditioners, multigrid methods.

Recommended previous knowledge:
Basic knowledge of numerical mathematics, such as that acquired in the modules "Numerical Mathematics 1" and "Numerical Mathematics 2", is required. Knowledge of the contents of the module "Basics in Optimization" is also recommended.

Intended learning outcomes

The student is acquainted with the most important methods for solving large systems of equations, and knows the most efficient way to solve a given system of equations.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Basics in Optimization			10-M=AOPT-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Fundamental methods and techniques in continuous optimization, unrestricted optimization, conditions for optimality, restricted optimization, examples and applications in natural and engineering sciences as well as economics.

Intended learning outcomes

The student knows the fundamental methods of continous optimization, can judge their strengths and weaknesses and can decide which method is the most suitable in applications.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Control Theory	10-M=ARTH-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Introduction to mathematical systems theory: stability, controllability and observability, state feedback and stability, basics in optimal control.

Recommended previous knowledge:
Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of control theory. He/She is able to establish a connection between these results and broader theories, and learns about the interactions of geometry and other fields of mathematics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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)
exchange program Mathematics (2023)

Module title			Abbreviation
Stochastic Models of Risk Management			10-M=ASMR-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Measure theory, risk diagrams, failure mode and effects analysis, risk assessment in auditing, shortfall measures, value at risk, conditional value at risk, axiomatic of risk measures, modelling of interdependencies, copula, 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.

Intended learning outcomes

The student is acquainted with the fundamental methods of stochastic risk analysis.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Stochastical Processes	10-M=ASTP-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Markov chains, queues, stochastic processes in C[0,1], Brownian motion, Donsker's theorem, projective limits.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of stochastical processes and can apply them to practical problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Topology			10-M=ATOP-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Set-theoretic topology, topological invariants (e. g. fundamental group, connection), construction of topological spaces, covering spaces.

Intended learning outcomes

The student is acquainted with the fundamental results, theorems and methods in topology and is able to apply these to common problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Insurance Mathematics 1			10-M=AVSM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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.

Intended learning outcomes

The student is acquainted with the fundamental notions and methods of life insurance mathematics and can apply them to practical problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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) 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 Series Analysis	10-M=AZRA-212-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Additive model, linear filters, autocorrelation, moving average, autoregressive processes, Box-Jenkins method.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental methods of time series analysis and can apply them to practical problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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
Number Theory			10-M=AZTH-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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 "Introduction to Algebra", „Introduction to Number Theory“ and "Applied Algebra".

Intended learning outcomes

The student is acquainted with the fundamental methods of analytics number theory, can deal with algebraic structures in number theory and knows methods for the solution of diophantine equations. He/She has insight into modern developments in number theory.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Giovanni Prodi Lecture (Master)			10-M=AGPCin-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (3) + Ü (1)
Module taught in: 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. 60 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)
Language of assessment: English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 degree (1 major) Mathematics (2022)

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
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

In-depth discussion of a specialised topic in analysis taking into account recent developments and interrelations with other mathematical concepts.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is acquainted with advanced results in a selected topic in analysis, and is able to apply these to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Algebraic Topology			10-M=VATP-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Homology, homotopy invariance, exact sequences, cohomology, application to the topology of Euclidean spaces.

Recommended previous knowledge:
Basic knowledge of topology is assumed, such as can be acquired in the module "Introduction to Topology".

Intended learning outcomes

The student is acquainted with advanced results in algebraic topology.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) Mathematical Physics (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) 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)
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
Selected Topics in Financial Mathematics			10-M=VFNM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in financial mathematics, e. g. conditional expectation and martingales, fundamental theorem of asset pricing in discrete time for finite spaces, American put, Snell envelope, stopping time, optimal stopping, stochastic integration, stochastic differential equations and Ito calculus, Black-Merton-Scholes model.

Recommended previous knowledge:
Familiarity with the contents of the modules "Introduction to Stochastic Financial Mathematics" and "Stochastics 1" is strongly recommended.

Intended learning outcomes

The student is acquainted with advanced results in financial mathematics. He/She gains the ability to work on contemporary research questions in financial mathematics and can apply his/her skills to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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) 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

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Finite permutation groups and character theory of finite groups, interrelations and special techniques such as the S-rings of Schur.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in group theory and representation theory and can apply his/her skills to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Geometrical Mechanics	10-M=VGEM-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: symplectic geometry, cotangent bundles and other examples of symplectic manifolds, symmetries and Noether theorem, phase space reduction, normal forms, introduction to Poisson geometry.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the module "Introduction to Topology" is also recommended. Knowledge of theoretical mechanics can also be useful.

Intended learning outcomes

The student is acquainted with selected advanced applications of differential geometry to geometric mechanics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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) 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) Mathematics (2022)
Master's degree (1 major) Mathematical Physics (2022)
exchange program Mathematics (2023)
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
Industrial Statistics 2			10-M=VIST-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Linear models, regression analysis, nonlinear regression, experimental design, basics in time series modelling, basics in empirical time series analysis, methods of exponential smoothing, predictions and prediction domains, statistical process monitoring.

Intended learning outcomes

The student masters advanced statistical methods for industrial applications.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)

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
Field Arithmetics	10-M=VKAR-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Combination of Galois theory, group theory and the theory of function fields with the aim of application in number theory, e. g. topics around Hilbert's irreducibility theorem, permutation polynomials (e. g. Calitz-Wan-conjecture) and the inverse problem in Galois theory.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters advanced algebraic concepts and methods. He/She gains the ability to work on contemporary research questions in algebra and can apply his/her skills to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) Mathematical Physics (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) 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
Numeric of Partial Differential Equations	10-M=VNPE-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Types of partial differential equations, qualitative properties, finite differences, finite elements, error estimates (numerical methods for elliptic, parabolic and hyperbolic partial differential equations; finite elements method, discontinuous Gelerkin finite elements method, finite differences and finite volume methods).

Recommended previous knowledge:
We recommend basic knowledge of functional analysis and partial differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Applied Analysis".

Intended learning outcomes

The student is acquainted with advanced methods for discretising partial differential equations.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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)

Module title			Abbreviation
Selected Topics in Optimization			10-M=VOPT-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in optimization, e. g. inner point methods, semidefinite programs, non-smooth optimization, game theory, optimization with differential equations.

Intended learning outcomes

The student is acquainted with advanced methods in continuous optimization. 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 (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)

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
Mathematical Statistics	10-M=VSTA-212-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Contingency tables, categorical regression, one-factorial variance analysis, two-factorial variance analysis, discriminant function analysis, cluster analysis, principal component analysis, factor analysis.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student is acquainted with the fundamental methods in statistical analysis and can apply them to practical problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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
Insurance Mathematics 2	10-M=VVSM-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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 applications, joint life policies.

Recommended previous knowledge:
Familiarity with the contents of the modules "Insurance Mathematics 1" and "Selected Topics in Financial Mathematics" is strongly recommended.

Intended learning outcomes

The student is acquainted with advanced methods in insurance mathematics. He gains the ability to work on contemporary research questions in insurance mathematics and can apply his/her skills to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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) 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
Discrete Mathematics			10-M=VDIM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advanced methods and results in a selected field of discrete mathematics (e. g. coding theory, cryptography, graph theory or combinatorics)

Recommended previous knowledge:
Basic knowledge of the contents of the module "Introduction to Discrete Mathematics" is required.

Intended learning outcomes

The student is acquainted with advanced results in a selected topic in discrete mathematics.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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) Economathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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) 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
Dynamical Systems			10-M=VDSY-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Fundamentals of dynamical systems, e. g. stability theory, ergodic theory, Hamiltonian systems.

Recommended previous knowledge:
Basic knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student masters the mathematical methods in the theory of dynamic systems, and is able to analyse their quality.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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)
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
Aspects of Geometry	10-M=VGEO-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

In-depth discussion of a special type of geometry taking into account recent developments and interrelations with other mathematical structures, e. g. topological geometries, diagram geometries.

Recommended previous knowledge:
Basic knowledge from the modules "Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is acquainted with advanced results in a selected field of geometry and can apply his/her skills to complex problems.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Mathematical Continuum Mechanics			10-M=VKOM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Partial differential equations and/or variational methods in the context of continuum mechanics.

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.

Intended learning outcomes

The student masters the mathematical methods in mathematical continuum mechanics and knows about their main fields of application.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 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
Mathematical Imaging	10-M=VMBV-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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.

Intended learning outcomes

The student masters the mathematical methods in the theory of image processing and knows about their main fields of application.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 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
Selected Topics in Mathematical Physics			10-M=VMPH-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in mathematical physics, for example continuum mechanics, fluid dynamics, mathematical material sciences, geometric field theory, advanced topics in quantum theory.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is acquainted with an advanced topic in mathematical physics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Selected Topics in Control Theory			10-M=VTRT-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in linear and non-linear control theory, e. g. networked linear control systems, controllability of bilinear systems.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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)

Module title			Abbreviation
Inverse Problems 1			10-M=VIPR-222-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Linear operator equations, ill-posed problems, regularisation theory, Tikhonov regularisation, iterative regularisation methods, examples of ill-posed problems.

Recommended previous knowledge:
Basic knowledge of functional analysis, such as that taught in the module "Functional Analysis", is recommended.

Intended learning outcomes

The student can judge whether a given problem is well posed or ill posed. He/She can apply regularisation methods and examine them regarding stability and convergence, and is familiar with selected inverse problems.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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
Module Theory	10-M=VMTH-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Basics in module theory: modules and module spaces, canonical decomposition and representations, simple, semi-simple and complex modules, module trees and their defibrations, distorsion theorems, reduction theorems.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student masters mathematical methods in module theory and is able to analyse their quality.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Non-linear Analysis	10-M=VNAN-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Methods in nonlinear analysis (e. g. topological methods, monotony and variational methods) with applications.

Recommended previous knowledge:
We recommend basic knowledge of functional analysis and partial differential equations, such as can be acquired in the modules "Introduction to Functional Analysis" and "Applied Analysis".

Intended learning outcomes

The student is acquainted with the concepts of non-linear analysis, can compare them and assess their applicability on practical problems.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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)
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
Optimal Control			10-M=VOST-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 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) 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)
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
Networked Systems	10-M=VVSY-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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 knowledge of the contents of the module "Ordinary Differential Equations" is useful.

Intended learning outcomes

The student is acquainted with advanced methods in the field of networked systems. He gains the ability to work on contemporary research questions in networked systems.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 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
Complex Geometry	10-M=VKGE-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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.

Intended learning outcomes

The student knows and masters advanced methods and notions in complex differential geometry. He is familiar with the central concepts in this fied and is able to apply the fundamental proof methods independently.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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 Differential Equations of Mathematical Physics			10-M=VPDP-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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; extensions 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.

Intended learning outcomes

The student is acquainted with fundamental concepts and solution methods in the theory of partial differential equations, as well as standard examples from mathematical physics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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)
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
Pseudo Riemannian and Riemannian Geometry	10-M=VPRG-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

The module builds on the topics covered in module 10-M=ADGM and discusses these in more detail: Riemannian and pseudo-Riemannian manifolds, Levi-Civita connection and curvature, geodesics and the exponential map, Jacobi fields, comparison theorems in Riemannian geometry, submanifolds, integration, d'Alembert and Laplace operators, causal structure of Lorenz manifolds, Einstein equations and applications in general relativity theory.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the modules "Introduction to Topology", "Geometric Mechanics" and "Lie Theory" is also recommended.

Intended learning outcomes

The student is acquainted with advanced topics in differential geometry on Riemannian and pseudo-Riemannian manifolds. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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 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
Functional Analysis			10-M=AFAN-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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:
Familiarity with the contents of the module "Advanced Analysis" is strongly recommended.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in a contemporary field of functional analysis, and is able to apply these skills to complex questions.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Applied Differential Geometry	10-M=VADG-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

The module builds on the topics covered in module 10-M=ADGM and discusses selected applications of differential geometry, e. g. at the interface of control theory and mechanics (subriemannian geometry), in the smooth optimisation 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 Geometry". Knowledge of the contents of the modules "Applied Differential Geometry", "Geometric Mechanics", "Pseudo-Riemannian and Riemannian Geometry" and "Lie Theory" is also recommended.

Intended learning outcomes

The student is acquainted with selected advanced applications of differential geometry. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)
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
Giovanni Prodi Lecture Selected Topics (Master)			10-M=VGPSin-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)
Module taught in: 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, 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: English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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Additional information

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Workload

300 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 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 degree (1 major) Mathematics (2022)

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
Giovanni Prodi Lecture Advanced Topics (Master)			10-M=VGPAin-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)
Module taught in: 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, 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: English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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Additional information

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Workload

300 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 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 degree (1 major) Mathematics (2022)

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			Abbreviation
Giovanni Prodi Lecture Modern Topics (Master)			10-M=VGPMin-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Introduction to a specialised topic in mathematics by an international expert.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of a contemporary research topic in mathematics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and applications in other subjects.

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

V (4) + Ü (2)
Module taught in: 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, 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: English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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Additional information

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Workload

300 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 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 degree (1 major) Mathematics (2022)

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	Abbreviation
Analysis and Geometry of Classical Systems	10-M=MP1-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Modern analytic methods (such as partial differential equations) and geometric methods (such as differential geometry) for the description of classical physics. Examples include movements of deformable bodies as reaction to outer load (deformation of elastic bodies, flow of a fluid, stream of a gas). Additional examples include geometric mechanics and symplectic geometry, classical field theory and classical gauge theory, general relativity theory.

Recommended previous knowledge:
Basic knowledge from the modules "Differential Geometry", "Introduction to Topology" and "Geometric Analysis" is recommended. Furthermore, basic knowledge of classical field theory is useful.

Intended learning outcomes

The student gains insight into modern methods in mathematics, which are applied in classical physics. He/She masters advanced techniques in this field and is able to apply them to complex problems.

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

V (4) + Ü (2)
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. 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
creditable for bonus

Allocation of places

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Additional information

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Workload

300 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) Mathematical Physics (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) 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
Algebra and Dynamics of Quantum Systems			10-M=MP2-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Modern algebraic methods for dynamics of quantum systems, e. g. operator algebras with applications in algebraic quantum field theory, spectral theory, symmetries and representation theory.

Recommended previous knowledge:
Basic knowledge from the modules "Functional Analysis", "Introduction to Topology" and "Introduction to Complex Analysis" is recommended. Basic knowledge of quantum mechanics is also useful.

Intended learning outcomes

The student gains insight into modern methods in mathematics, which are applied in quantum physics. He/She masters advanced techniques in this field and is able to apply them to complex problems.

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

V (4) + Ü (2)
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. 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
creditable for bonus

Allocation of places

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Additional information

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Workload

300 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) Mathematical Physics (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) 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
Geometric Complex Analysis			10-M=VGFT-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advanced methods and results in geometric complex analysis (e.g. conformal maps, conformal Riemannian metrics, quasiconformal maps, harmonic functions, biholomorphic maps).

Recommended previous knowledge:
Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended.

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in geometric complex analysis, is able classify these results within more general theories and knows about the connections of geometric complex analysis with other fields of mathematics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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
Selected Topics in Numerical and Applied Mathematics			10-M=VNAM-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

In-depth discussion of a specialised topic in numerical or applied mathematics taking into account recent developments and interrelations with other mathematical concepts.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of applied mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is acquainted with advanced results in a selected topic in numerical or applied mathematics, and is able to apply these to complex problems.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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)

Module title			Abbreviation
Cryptography/Coding Theory			10-M=VKRY-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Error detection and error correction, linear codes, channel coding theorems of Shannon, classical and contemporary codes, bounds, network codes, connections to cryptography.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in coding theory and cryptography, is able to classify these results within more general theories and knows about the connections of coding theory and cryptography with other fields of mathematics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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
Computer Algebra	10-M=VCAL-192-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Fast multiplication of numbers, polynomials and matrices, fast chinese remainder theorem; factorisation of polynomials over finite fields; lattices, lattice basis reduction and LLL-algorithm; factorisation of rational polynomials, symbolic integration of rational functions; exact arithmetic with algebraic numbers; multivariate polynomials, Gröbner basis, Buchberger's algorithm, algorithms for permutation groups.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student knows about the theoretical foundations and the possible applications of several methods in computer algebra.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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
Algorithmic Number Theory			10-M=VAZT-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Binary numbers, computation of the greatest common divisor, pseudoprime tests, computation of primitive roots. Primality tests for Fermat and Mersenne numbers, factorisation methods (Pollard-Rho, (p-1)-method, elliptic curve method, quadratic sieve method), discrete logarithm.

Recommended previous knowledge:
Basic knowledge of algebra and number theory is assumed, such as can be acquired in the modules "Introduction to Algebra", „Introduction to Number Theory“ and "Applied Algebra".

Intended learning outcomes

The student knows about the theoretical foundations and the possible applications of several methods in algorithmic number theory.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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
Algebraic Geometry	10-M=VAGE-192-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Affine and projective space, affine and projective varieties, morphisms and rational maps; function fields, divisors 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".

Intended learning outcomes

The student is acquainted with fundamental concepts, methods and results in algebraic geometry, is able to classify these results within more general theories and knows about the connections of algebraic geometry with other fields of mathematics.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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 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
Analytic Number Theory	10-M=AAZT-222-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Riemannian Zeta-function, Euler products and Dirichlet L-series, prime number theorem in arithmetic progression, sums of two squares, exponential sums.

Recommended previous knowledge:
Basic knowledge of number theory and complex analysis is assumed, such as can be acquired in the modules "Introduction to Number Theory" and "Introduction to Complex Analysis".

Intended learning outcomes

The students are fasmiliar with classical methods in analytic number theory. They are able to apply them to related questions.

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

V (4) + Ü (2)
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. 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

Allocation of places

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Additional information

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Workload

300 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) 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
Inverse Problems 2			10-M=VIP2-222-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Variational regularisation methods, source conditions, non-linear operator equations.

Recommended previous knowledge:
Basic knowledge of functional analysis, such as that taught in the module "Functional Analysis", is recommended, as well as the contents of the module "Inverse Problems 1" if applicable.

Intended learning outcomes

The students understand the particular difficulties of nonlinear problems and know solution methods for those. They have the ability to apply variational regularisation methods and to examine them with respect to stability and convergence. They gain deeper knowledge in selected inverse problems.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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
Selected Topics in Complex Analysis			10-M=VAFT-222-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advanced methods and results of complex analysis on the basis of selected topics such as spectral complex analysis or operator theory as well as exemplary applications of this, e.g. in functional analysis, harmonic analysis, approximation theory, the theory of partial differential equations or mathematical physics.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Complex Analysis" and " Complex Analysis" or "Geometric Complex Analysis" is recommended.

Intended learning outcomes

The student is familiar with the basic concepts, methods and results of higher complex analysis and in particular has a familiarity with the properties of holomorphic functions. He/she can relate the acquired skills to other branches of mathematics and application subjects.

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. 60 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)
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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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)

Subfield Research in Groups and Seminars

(10 ECTS credits)

Module title	Abbreviation
Research in Groups - Algebra	10-M=GALG-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in algebra (e. g. ring theory, commutative algebra, differential algebra, local fields, computer algebra, algebras, division rings, quadratic forms).

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student gains insight into contemporary research problems in algebra. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Discrete Mathematics			10-M=GDIM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in discrete mathematics.

Intended learning outcomes

The student gains insight into contemporary research problems in discrete mathematics. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Dynamical Systems and Control Theory	10-M=GDSC-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in dynamical systems and control theory.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in dynamical systems and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title			Abbreviation
Research in Groups - Complex Analysis			10-M=GCOA-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in complex analysis (e. g. in approximation theory, potential theory, complex dynamics, geometric complex analysis, value distribution theory).

Recommended previous knowledge:
Depending on the current focus of the course, knowledge from different areas of analysis is required. Consultation with the lecturer at the beginning of the course is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in complex analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Geometry and Topology			10-M=GGMT-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in geometry and topology.

Intended learning outcomes

The student gains insight into contemporary research problems in geometry and topology. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Mathematics in Context			10-M=GMCX-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Reflection on mathematics in a cultural context, for example by discussing part of the history of mathematics, given by a historical period, a geographic region or a particular field of mathematics. Other possibilities arise from the connection of mathematics with literature, language, music, art or the media.

Intended learning outcomes

The student realises the cultural dimension of mathematics and its relation to other cultural fields.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Mathematics in the Sciences			10-M=GMSC-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in mathematics in the sciences.

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.

Intended learning outcomes

The student gains insight into contemporary research problems in mathematics in the sciences. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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)
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
Research in Groups - Measure and Integral	10-M=GMAI-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Aspects of measure and integration theory: sigma algebras and Borel sets, volume and measure, measurable functions and Lebesgue integrals, selected applications, e. g. product measures (with Fubini's theorem and the transformation rule), Lp spaces and absolute continuity, measures on topological spaces.

Intended learning outcomes

The student gains insight into contemporary research problems in measure and integration theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Economathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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) Economathematics (2025)

Module title	Abbreviation
Research in Groups - Numerical Mathematics and Applied Analysis	10-M=GNMA-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected topics in numerical mathematics, applied analysis or scientific computing.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis and/or numerical mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student gains insight into a contemporary research problems in numerical mathematics or applied analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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)

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
Research in Groups - Robotics, Optimization and Control Theory	10-M=GROC-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in robotics, optimisation and control theory.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in robotics, optimization and control theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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)
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
Research in Groups - Time Series Analysis			10-M=GTSA-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in time series analysis.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in time series analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Economathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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) Economathematics (2025)

Module title	Abbreviation
Research in Groups - Statistics	10-M=GSTA-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in statistics.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended. Depending on the content of the course, other prior knowledge may also be helpful; consultation with the lecturer is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in statistics. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title			Abbreviation
Research in Groups - Number Theory			10-M=GNTH-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in number theory (e. g. algebraic number theory, modular forms, diophantine analysis).

Recommended previous knowledge:
Basic knowledge of algebra and number theory is assumed, such as can be acquired in the modules "Introduction to Algebra", „Introduction to Number Theory“ and "Applied Algebra".

Intended learning outcomes

The student gains insight into contemporary research problems in numer theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Control Theory of Quantum Mechanical Systems			10-M=GCQS-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in control theory of quantum mechanical systems.

Intended learning outcomes

The student gains insight into contemporary research problems in control theory of quantum mechanical systems. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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)

Module title	Abbreviation
Research in Groups - Differential Geometry	10-M=GDGE-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in differential geometry.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the modules "Applied Differential Geometry", "Geometric Mechanics", "Pseudo-Riemannian and Riemannian Geometry" and "Lie Theory" is also recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in Differential Geometry. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Deformation Quantization	10-M=GDFQ-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in deformation quantization.

Recommended previous knowledge:
Knowledge of the contents of the modules "Differential Geometry" and "Geometric Mechanics" is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in Deformation Quantization. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Research in Groups - Non-linear Analysis			10-M=GNLA-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in non-linear analysis.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student gains insight into contemporary research problems in Non-linear Analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title	Abbreviation
Research in Groups - Operator Algebras	10-M=GOPA-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in operator algebras.

Recommended previous knowledge:
Knowledge of the contents of the modules "Functional Analysis" and "Algebra and Dynamics of Quantum Systems" is recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in Operator algebras. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) Mathematical Physics (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) 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
Seminar in Applied Differential Geometry			10-M=SADG-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in applied differential geometry.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the modules "Applied Differential Geometry", "Geometric Mechanics", "Pseudo-Riemannian and Riemannian Geometry" and "Lie Theory" is also recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Seminar in Algebra	10-M=SALG-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

A modern topic in algebra.

Recommended previous knowledge:
Basic knowledge of algebra is assumed, such as can be acquired in the modules "Introduction to Algebra" and "Applied Algebra".

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Seminar in Dynamical Systems and Control	10-M=SDSC-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

A modern topic in dynamical systems and control.

Recommended previous knowledge:
Knowledge of the contents of the module "Mathematical Control Theory" or "Control Theory" is required.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title			Abbreviation
Seminar in Complex Analysis			10-M=SCOA-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in complex analysis.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Complex Analysis" and " Complex Analysis" is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Seminar in Financial and Insurance Mathematics			10-M=SFIM-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in financial and insurance mathematics.

Recommended previous knowledge:
Familiarity with the contents of the modules "Introduction to Stochastic Financial Mathematics" and "Stochastics 1" is strongly recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) Mathematics (2016)
Master's degree (1 major) Economathematics (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) 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) Economathematics (2025)

Module title			Abbreviation
Seminar in Geometry and Topology			10-M=SGTO-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in geometry and topology.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Differential Geometry" and "Introduction to Topology" is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) Mathematics (2016)
Master's degree (1 major) Mathematical Physics (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) 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
Giovanni Prodi Seminar (Master)	10-M=SGPCin-152-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

A modern topic in the research expertise of the current holder of the Giovanni Prodi Chair.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
Module taught in: 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)

talk (60 to 120 minutes)
Language of assessment: 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

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) Mathematics International (2015)
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 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) 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) Mathematics International (2022)

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=SIDC-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in mathematics with interdisciplinary aspects.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) 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)
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 Mathematics in the Sciences			10-M=SMSC-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in mathematics in the sciences.

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.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) 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)

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-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in numerical mathematics or applied analysis.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis and/or numerical mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) 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)

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
Seminar in Optimization			10-M=SOPT-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in optimisation.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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) 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)
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
Seminar in Statistics	10-M=SSTA-161-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

A modern topic in statistics.

Recommended previous knowledge:
Basic knowledge of stochastics is required, such as that acquired in the "Stochastics 1" module. Knowledge of the contents of the module "Stochastics 2" is also recommended. Depending on the content of the course, other prior knowledge may also be helpful; consultation with the lecturer is recommended.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title			Abbreviation
Seminar in Non-linear Analysis			10-M=SNLA-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in non-linear analysis.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

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

Module title			Abbreviation
Seminar Applied Mathematics			10-M=SAMA-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

A modern topic in applied mathematics.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of applied mathematics is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student is able to elaborate a contemporary research topic. This includes comprehending and structuring of the topic and the available literature, preparing a talk and the ability to participate in a scientific discussion.

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

S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

150 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) 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)

Module title	Abbreviation
Research in Groups - Lie Theory	10-M=GLIE-192-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Selected modern topics in Lie Theory.

Recommended previous knowledge:
Knowledge of the contents of the module "Lie theory" is required.

Intended learning outcomes

The student gains insight into contemporary research problems in Lie Theory. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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 (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
Research in Groups - Applied Differential Geometry			10-M=GADG-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in Applied Differential Geometry.

Recommended previous knowledge:
Advanced knowledge of differential geometry is required, such as can be acquired in the module "Differential Geometry". Knowledge of the contents of the modules "Introduction to Topology", "Geometric Mechanics", "Pseudo-Riemannian and Riemannian Geometry" and "Lie Theory" is also recommended.

Intended learning outcomes

The student gains insight into contemporary research problems in Applied Differential Geometry. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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 (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
Research in Groups - Mathematical Physics			10-M=GMAP-192-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in Mathematical Physics.

Recommended previous knowledge:
Depending on the content, basic and advanced knowledge from different areas of analysis and/or differential geometry is required. In case of doubt, it is recommended to consult the lecturer.

Intended learning outcomes

The student gains insight into contemporary research problems in Mathematical Physics. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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 (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
Research in Groups - Higher Structures			10-M=GHST-222-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics on higher structures and higher symmetries in differential geometry and topology.

Recommended previous knowledge:
Basic knowledge of the contents of the modules "Introduction to Differential Geometry" and "Introduction to Topology" is recommended. Basic knowledge of algebra is also useful.

Intended learning outcomes

The student gets acquainted with current problems in the study of higher structures (e.g. multiple vector bundles and multiple structures, Lie n-algebroids and Lie n-groupoids, graded geometry, representations up to homotopy).

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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 - Functional Analysis	10-M=GFAN-222-m01

Module coordinator	Module offered by
Dean of Studies Mathematik (Mathematics)	Institute of Mathematics

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Advanced topics in functional analysis, for example local convex analysis, spectral theory, global analysis. The research in groups treats conceptional foundations of fuctional analysis as well as relations to other fields of analysis.

Recommended previous knowledge:
Knowledge of the contents of the module "Functional Analysis" is required. Further knowledge from other areas of analysis may also be useful.

Intended learning outcomes

The student gains insight into contemporary research problems in functional analysis. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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 - Inverse Problems			10-M=GINP-222-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected modern topics in inverse problems.

Recommended previous knowledge:
After consultation with the lecturer, prior knowledge from the modules "Inverse Problems 1" and possibly "Inverse Problems 2" is recommended. The reseaarch in groups usually builds on the content of a course from the previous semester.

Intended learning outcomes

The student gains insight into contemporary research problems in inverse problems. He/She masters advanced techniques in this field and can apply them to complex problems.

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

V (2) + S (2)
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)

talk (60 to 120 minutes)
Language of assessment: German 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

300 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) 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)

Subfield Learning and Teaching

(ECTS credits)

Module title			Abbreviation
Learning by Teaching 1			10-M=ELT1-192-m01
Module coordinator		**Module offered by**	
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)

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

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Additional information

Application and selection with the teaching coordinator for mathematics

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) Computational 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) 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 degree (1 major) Economathematics (2025)

Module title			Abbreviation
Learning by Teaching 2			10-M=ELT2-192-m01
Module coordinator		**Module offered by**	
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)

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

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Additional information

Application and selection with the teaching coordinator for mathematics

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) Mathematics (2019)
Master's degree (1 major) Mathematics (2022)
exchange program Mathematics (2023)
Master's degree (1 major) Mathematics (2024)

Subfield Optional Application Subject and/or Intership

(ECTS credits)

Application Subject Biology

(ECTS credits)

Module title			Abbreviation
Bioinformatics			07-MS2BI-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advances and current results of bioinformatics are explained and discussed, this includes results from genome and sequence analysis, protein domains and protein families, large-scale data analysis (e. g. net generation sequences, proteomics data), analysis of different functional RNAs (e. g. miRNAs, lncRNAs).

Intended learning outcomes

Understand recent results in bioinformatics. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions in bioinformatics.

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

V (2) + S (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 (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

Allocation of places

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Additional information

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Workload

300 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) 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)
Master's degree (1 major) Biosciences (2018)
Master's degree (1 major) Computational Mathematics (2019)

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) 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 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
Bioinformatics F1	07-MS2BIF1-152-m01

Module coordinator	Module offered by
holder of the Chair of Bioinformatics	Faculty of Biology

ECTS	Method of grading	Only after succ. compl. of module(s)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Detailed insight into methods in bioinformatics; depending on the topic selected, fields covered include: genomics (sequence-, domain analysis and annotation), omics data analysis (NGS, transcriptomics, metabolomics, proteomics), topological and structural analysis of biological interactions including statistical methods, phylogenetic analysis, protein structure analysis. Results are documented in the form of a presentation, a publication or a term paper.

Intended learning outcomes

Students have gained knowledge on experimental setups and methods used in the field of bioinformatics. They are able to design experiments, collect data and interpret them statistically, adhering to the principles of good scientific practice.

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

P (14) + S (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 (30 to 60 minutes, including multiple choice questions) or
b) log (15 to 30 pages) 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) or
e) presentation (20 to 45 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 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) 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) 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) 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-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
15	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advanced insight into methods in bioinformatics; depending on the topic selected, fields covered include: genomics (sequence-, domain analysis and annotation), omics data analysis (NGS, transcriptomics, metabolomics, proteomics), topological and structural analysis of biological interactions including statistical methods, phylogenetic analysis, protein structure analysis. The techniques applied are evaluated on the basis of the results obtained and are modified where necessary. Results are documented in the form of a presentation, a publication or a term paper.

Intended learning outcomes

Proficiency in one or more methods in bioinformatics that allows students to independently perform and organise a scientific project in the field of bioinformatics and to document the results obtained. Students are able to design a research project and are prepared for working on a scientific question for their thesis.

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

P (29) + S (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 (30 to 60 minutes, including multiple choice questions) or
b) log (15 to 30 pages) 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) or
e) presentation (20 to 45 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

450 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) 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) 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) 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 B			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. compl. of module(s)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advances and current results of bioinformatics are explained and discussed, this includes results from genome and sequence analysis, protein domains and protein families, large-scale data analysis (e. g. net generation sequences, proteomics data), analysis of different functional RNAs (e. g. miRNAs, lncRNAs).

Intended learning outcomes

Understand recent results in bioinformatics. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions in bioinformatics.

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

V (2)
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 (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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 (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)
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)

Module title			Abbreviation
Systems Biology			07-MS3S-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advances and current results of computational systems biology are explained and discussed, this includes results from functional genomics, dynamics of the transcriptome, of metabolism and metabolic networks as well as regulatory networks.

Intended learning outcomes

Understand recent results in systems biology. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions of systems biology.

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

V (2) + S (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 (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

Allocation of places

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Additional information

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Workload

300 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) 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)
Master's degree (1 major) Biosciences (2018)
Master's degree (1 major) Computational Mathematics (2019)

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
Systems Biology F1			07-MS3SYF1-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The practical course will provide students with advanced insights into a field of systems biology and will, in particular, 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 dynamics of protein-protein interactions, modelling cellular regulation; modelling metabolism, statistical modelling).

Intended learning outcomes

Students have gained knowledge on experimental setups and methods used in the field of systems biology. They are able to design scientific research, to collect data and to interpret them statistically, adhering to the principles of good scientific practice.

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

P (14) + S (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 (30 to 60 minutes, including multiple choice questions) or
b) log (15 to 30 pages) 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) or
e) presentation (20 to 45 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

300 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) 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 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) 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
Systems Biology F2			07-MS3SYF2-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
15	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The practical course will provide students with advanced insights into a field of systems biology and will, in particular, 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 dynamics of protein-protein interactions, modelling cellular regulation; modelling metabolism, statistical modelling). The techniques applied are evaluated on the basis of the results obtained and are modified where necessary. Results are documented in the form of a presentation, a publication or a term paper.

Intended learning outcomes

Proficiency in one or more methods in systems biology that allows students to independently perform and organise a scientific project in the field of bioinformatics and to document the results obtained. Students are able to design a research project and are prepared for working on a scientific question for their thesis.

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

P (29) + S (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 (30 to 60 minutes, including multiple choice questions) or
b) log (15 to 30 pages) 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) or
e) presentation (20 to 45 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

450 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) 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) 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) 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
Systems Biology B			07-MS-B-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Advances and current results of computational systems biology are explained and discussed, this includes results from functional genomics, dynamics of the transcriptome, of metabolism and metabolic networks as well as regulatory networks.

Intended learning outcomes

Understand recent results in systems biology. Discuss their implications. Have an advanced (Master) level knowledge of typical technologies and research questions of systems biology.

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

V (2)
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 (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

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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 (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)

Application Subject Chemie

(ECTS credits)

Module title	Abbreviation
Laser Spectroscopy	08-PCM1a-161-m01

Module coordinator	Module offered by
lecturer of seminar "Laserspektroskopie" (Laser Spectroscopy)	Institute of Physical and Theoretical Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This module introduces students to the fundamental principles of laser spectroscopy. It discusses absorption and emission spectroscopy.

Intended learning outcomes

Students are able to explain the components and operating principles of lasers as well as the optical principles of laser technology. They are able to describe the principles of absorption and emission spectroscopy.

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

S (2) + Ü (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 minutes) or
b) oral examination of one candidate each (approx. 20 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Functional Materials (2022)
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 title	Abbreviation
Advanced Physical Chemistry (Lab)	08-PCM1b-161-m01

Module coordinator	Module offered by
lecturer of seminar "Laserspektroskopie" (Laser Spectroscopy)	Institute of Physical and Theoretical Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This module gives students the opportunity to use modern experimental methods in physical chemistry in the laboratory. After a safety briefing, the students autonomously conduct experiments in the laboratory. Students will be expected to take tests and write lab reports to demonstrate their knowledge.

Intended learning outcomes

Students have developed a high level of proficiency in modern experimental methods in physical chemistry.
They are able to analyse the resulting measurements and write a lab report.

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

P (4)
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)

Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical performance (2 to 4 random examinations)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: block taught lab course with approx. 20 working days.

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) Chemistry (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) 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)
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
Statistical Mechanics and Reaction Dynamics	08-PCM2-161-m01

Module coordinator	Module offered by
lecturer of seminar "Chemische Dynamik" (Chemical Dynamics)	Institute of Physical and Theoretical Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This module discusses selected topics in statistical mechanics and reaction dynamics. Topics to be covered include the fundamental principles of statistical thermodynamics, the transition state theory, uni- and bimolecular reactions as well as charge and energy transfer.

Intended learning outcomes

Students have become familiar with selected topics in statistical mechanics and reaction dynamics. They have learned and are able to apply the fundamental principles of statistical thermodynamics.

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

S (2) + Ü (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 minutes) or
b) oral examination of one candidate each (approx. 20 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Functional Materials (2022)
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 title	Abbreviation
Nanoscale Materials	08-PCM3-161-m01

Module coordinator	Module offered by
lecturer of the seminar "Nanoskalige Materialien"	Institute of Physical and Theoretical Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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

Intended learning outcomes

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

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

S (2) + Ü (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 minutes) or
b) oral examination of one candidate each (approx. 20 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Bachelor'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 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
Ultrafast spectroscopy and quantum-control			08-PCM4-161-m01
Module coordinator		**Module offered by**	
lecturer of the seminar "Nanoskalige Materialien"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Prior completion of modules 08-PCM1a and 08-PCM1b recommended.	

Contents

This module discusses advanced topics in ultrafast spectroscopy and quantum control. It focuses on ultrashort laser pulses, time-resolved laser spectroscopy and coherent control.

Intended learning outcomes

Students are able to describe the generation of ultrashort laser pulses and to characterise them. They can explain the theory of time-resolved laser spectroscopy and name experimental methods. They can describe the principles and applications of quantum control.

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

S (2) + Ü (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 minutes) or
b) oral examination of one candidate each (approx. 20 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
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) Chemistry (2018)
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) 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 (2024)
Master's degree (1 major) Mathematics (2024)

Module title			Abbreviation
Physical Chemistry of Supramolecular Assemblies			08-PCM5-161-m01
Module coordinator		**Module offered by**	
lecturer of the seminar "Physikalische Chemie Supramolekularer Strukturen"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module examines the basic interactions between molecules. It discusses the formation and physical-chemical properties of aggregates as well as key applications of supramolecular chemistry.

Intended learning outcomes

Students are able to explain the basic interactions between molecules demonstrating a high degree of expertise in the field. They can describe the formation and physical-chemical properties of aggregates. They can name modern applications of supramolecular chemistry.

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

S (2) + Ü (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 minutes) or
b) oral examination of one candidate each (approx. 20 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

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

Module title			Abbreviation
Physical Chemistry (Advanced Lab)			08-PCM6-161-m01
Module coordinator		**Module offered by**	
lecturers Physikalische Chemie (Physical Chemistry)		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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.

Intended learning outcomes

Students have become proficient in the research methods typically used by the relevant physical chemistry research group. They are able to analyse their findings and thus help answer topical questions in physical chemistry.

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

P (4)
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)

presentation (approx. 20 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: block taught lab course with approx. 20 working days.

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) Chemistry (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) 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)
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 and Applications of Quantum Chemistry			08-TCM2-161-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Computational Chemistry"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module introduces students to the fundamental principles of computational chemistry.

Intended learning outcomes

Students are able to explain the theoretical principles of computational chemistry and to apply methods in computational chemistry.

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

S (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Functional Materials (2022)
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 title			Abbreviation
Numerical Methods and Programming			08-TCM3-161-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Programmieren in Theoretischer Chemie"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module provides an introduction to the fundamentals of programming in theoretical chemistry and discusses its application areas.

Intended learning outcomes

Students are able to explain and use one of the programming languages typically used in theoretical chemistry as well as to name its application areas.

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

S (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 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) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Functional Materials (2022)
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 title			Abbreviation
Quantum Dynamics			08-TCM4-161-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Quantendynamik"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Time-dependent Schrödinger equation, propagators, time-dependent perturbation theory, adiabatic theorem, diabatic and adiabatic states, non-adiabatic dynamics, mixed quantum-classical dynamics.

Intended learning outcomes

The students possess knowledge about the time-dependent description of the nuclear and electronic dynamics in molecules. Their insight into the methods and the numerical realizations allow them to carry out applications in the field of theoretical chemistry.

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

S (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 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) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Functional Materials (2022)
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 title			Abbreviation
Selected Topics in Theoretical Chemistry			08-TCM1-161-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Theoretische Chemie"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module introduces students to the fundamental principles of theoretical chemistry.

Intended learning outcomes

Students are able to describe the mathematical and physical principles underlying the quantum chemical and quantum dynamical approaches of theoretical chemistry.

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

S (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Chemistry (2016)
Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Master's degree (1 major) Chemistry (2018)
Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Computational Mathematics (2022)

Master's degree (1 major) Functional Materials (2022)
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 title			Abbreviation
Theoretical Chemistry - Project course quantum chemistry			08-TCAP1-161-m01
Module coordinator		**Module offered by**	
head of the research group offering the module		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to get involved in the work of one of the research groups based at the Institute of Theoretical Chemistry and learn some of the methods typically used in the discipline. The focus will be on quantum chemistry.

Intended learning outcomes

Students have learned some of the methods typically used in theoretical chemistry and, in particular, in quantum chemistry. They are able to explain issues that are relevant to the field of quantum chemistry.

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

P (5)

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

presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: block taught lab course with approx. 20 working days.

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) Chemistry (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) 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)
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 Chemistry - Project course quantum dynamics			08-TCAP2-161-m01
Module coordinator		**Module offered by**	
head of the research group offering the module		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to get involved in the work of one of the research groups based at the Institute of Theoretical Chemistry and learn some of the methods typically used in the discipline. The focus will be on quantum dynamics.

Intended learning outcomes

Students have learned some of the methods typically used in theoretical chemistry and, in particular, in quantum dynamics. They are able to explain issues that are relevant to the field of quantum dynamics.

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

P (5)

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

presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: block taught lab course with approx. 20 working days.

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) Chemistry (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) 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)
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 Computer Science and Aerospace Computer Science

(ECTS credits)

Module title			Abbreviation
Seminar 1 - Current Topics in Computer Science			10-I=SEM3-212-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Independent review of a current topic in computer science based on literature and, where applicable, software with written and oral presentation.

Intended learning outcomes

The students are able to independently review a current topic in computer science, to summarise the main aspects in written form and to orally present these in an appropriate way.

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

S (2)
Module taught in: German and English
The course is offered in parallel in both German and 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)

term paper (10 to 15 pages) and presentation (30 to 45 minutes) with subsequent discussion on a topic from the field of computer science
Language of assessment: German and/or English

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT, SE, IT, KI, ES, LR, HCI, GE

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

Module title			Abbreviation
Advanced Programming			10-I=APR-212-m01
Module coordinator		**Module offered by**	
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 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. 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)

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,KI,LR, HCI, ES,GE,SEC

Workload

150 h

Teaching cycle

Teaching cycle: every year, winter semester

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

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Module appears in

Master's degree (1 major) eXtended Artificial Intelligence (xtAI) (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) Information Systems (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) Artificial Intelligence & Extended Reality (2024)
Master's degree (1 major) Artificial Intelligence (2024)
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 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
Advanced Automation			10-I=AA-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VII		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

Advanced topics in automation systems as well as instrumentation and control engineering, for example from the field of sensor data processing, actuators, cooperating systems, mission and trajectory planning.

Intended learning outcomes

The students have an advanced knowledge of selected topics in automation systems. They are able to implement advanced automation systems.

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

V (4) + Ü (2)

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

written examination (approx. 60 to 120 minutes)
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): IT,IS,ES,LR,GE

Workload

240 h

Teaching cycle

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

§ 22 II 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 (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) 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 title			Abbreviation
Algorithms for Geographic Information Systems			10-I=AGIS-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Algorithmic foundations of geographic information systems and their application in selected problems of acquisition, processing, analysis and presentation of spatial information. Processes of discrete and continuous optimisation. Applications such as the creation of digital height models, working with GPS trajectories, tasks of spatial planning as well as cartographic generalisation.

Intended learning outcomes

The students are able to formalise algorithmic problems in the field of geographic information systems as well as to select and improve suitable approaches to solving these problems.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,KI,HCI,LR

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 (2021)
Master's degree (1 major) Aerospace 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) Aerospace Computer Science (2023)

Module title			Abbreviation
Computational Geometry			10-I=AG-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

In many areas of computer science -- for example robotics, computer graphics, virtual reality and geographic information systems -- it is necessary to store, analyse, create or manipulate spatial data. This class is about the algorithmic aspects of these tasks: We will acquire techniques that are needed to plan and analyse geometric algorithms and data structures. Every technique will be illustrated with a problem in the practical areas listed above.

Intended learning outcomes

The students are able to decide which algorithms or data structures are suitable for the solution of a given geometric problem. The students are able to analyse new problems and to come up with their own efficient solutions based on the concepts and techniques acquired in the lecture.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,HCI,GE

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 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 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			Abbreviation
Approximation Algorithms			10-I=APA-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The task of finding the optimal solution for a given problem is omnipresent in computer science. Unfortunately, there are many problems without an efficient algorithm for an optimal solution. As a result, in practice, methods are used which do not always give the optimal solution but always give good solutions. This lecture will discuss drafting and analysing techniques for algorithms which have a proven approximation quality. With the help of practical optimisation problems, the lecture will introduce students to important drafting techniques such as greedy, local search, scaling as well as methods based on linear programming.

Intended learning outcomes

The students are able to analyse easy approximation methods in terms of their quality. They understand fundamental drafting techniques such as greedy, local search and scaling as well as methods based on linear programming and are able to apply these to new problems.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,IT,GE

Workload

150 h

Teaching cycle

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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 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)
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)

Module title			Abbreviation
Automata Theory			10-I=AUT-212-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular languages and star-free languages, two-way automata.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular and star-free languages, two-way automata.

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

V (2) + Ü (2)

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

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

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT, IT, ES, HCI, GE

Workload

150 h

Teaching cycle

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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 (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
Avionics Systems			10-I=AVS-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VIII		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The course *Avionik-Systeme* (*Avionics Systems*) offers an overview of software, hardware, sensors, actuators and communication of airplanes and satellites: 1. software module and the software structure 2. control 3. ground control, 4. sensors and actuators, 5. sensor fusion, 6. reliability

Intended learning outcomes

At the end of the course, the students should be familiar with typical structures of avionic systems for satellites and airplanes. They should be able to design these. They should be able to program simple controls.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): ES,LR

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 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 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
Multimodal User Interfaces			10-HCI=MMUI-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IX		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The multimodal interaction paradigm simultaneously uses various modalities like speech, gesture, touch, or gaze, 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 processing. Input processing has the goal to derive meaning from signal to provide a computerized description and understanding of the input and to execute the desired interaction. In multimodal systems, this process is interleaved between various modalities and multiple interdependencies exist between simultaneous utterances necessary 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 multimodal input. The course will highlight typical stages in multimodal processing. Using speech processing as a primary 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 interdependencies, 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, including transducers, state machines, and unification.

Intended learning outcomes

After the course, the students will be able to build their own multimodal interfaces. They will have a broad understanding of all the necessary steps involved and will know prominent algorithmic solutions for each of them. Student will learn about available tools for reoccurring tasks and their pros and cons.

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

V (2) + Ü (2)

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

presentation of project results (approx. 40 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): HCI,GE.

Workload

150 h

Teaching cycle
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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)

Module title			Abbreviation
Computability Theory			10-I=BER-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Gödel numbering, computable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of Gödel numbers, countable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.

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

V (2) + Ü (2)

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

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

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,IT,KI,GE

Workload

150 h

Teaching cycle

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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 (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
Bioinformatics			07-BI-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental principles of bioinformatics.

Intended learning outcomes

Students are proficient in methods for the analysis of DNA and protein databases.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

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) 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)

Module title			Abbreviation
Introduction to Bioinformatics			07-BI-202-m01
Module coordinator		**Module offered by**	
holder of the Chair of Bioinformatics		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental principles of bioinformatics.

Intended learning outcomes

Students are proficient in methods for the analysis of DNA and protein databases.

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

V (0.5) + Ü (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)

Log (approx. 30 pages)

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Bachelor's degree (1 major) Biomedicine (2020)
Master's degree (1 major) Computer Science (2021)
Master's degree (1 major) Mathematics (2022)

Module title			Abbreviation
Compiler Construction			10-I=CB-161-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

Lexical analysis, syntactic analysis, semantics, compiler generators, code generators, code optimisation.

Intended learning outcomes

The students possess knowledge in the formal description of programming languages and their compilation. They are able to perform transformations between them with the help of finite automata, push-down automata and compiler generators.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IT,IS,GE

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 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) 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) 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 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
Deductive Databases			10-I=DDB-212-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Syntax and semantics of definite and normal logic programs; Model, proof, and fixpoint theory; Connection to relational databases; Evaluation methods for Datalog; Negation and stratification; Structural properties of logic programs: recursion, equivalence, transformation; Outlook on disjunctive logic programs.

Intended learning outcomes

The students have fundamental and practicable knowledge about Datalog (including negation).
They are able to compactly implement declarative programs in Datalog and to compare existing programs w.r.t. their equivalence and other properties.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,IT,KI

Workload

150 h

Teaching cycle

Teaching cycle: every year, summer semester

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 (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) Artificial Intelligence (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) Computer Science (2025)

Module title			Abbreviation
E-Learning			10-I=EL-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Learning paradigms, learning system types, author systems, learning platforms, standards for learning systems, intelligent tutoring systems, student models, didactics, problem-oriented learning and case-based training systems, adaptive tutoring systems, computer-supported cooperative learning, evaluation of learning systems.

Intended learning outcomes

The students possess a theoretical and practical knowledge about eLearning and are able to assess possible applications.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, KI, HCI, GE

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 (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)

Module title			Abbreviation
Embedded Systems			10-I=ES-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		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

Models of embedded systems, implementation methods (ASIC, AISIP, micro controller), verification of embedded systems, implementation planning static, periodic and dynamic, binding problems, hardware synthesis, software synthesis.

Intended learning outcomes

The students are familiar with the technical possibilities for the design of embedded systems and master the most important techniques for the modelling, verification and optimisation of such systems in hardware and software.

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

V (4) + Ü (2)

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

written examination (approx. 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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,ES,LR,GE

Workload

240 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 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 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			Abbreviation
Analysis and Design of Programs			10-I=PA-161-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

Program analysis, model creation in software engineering, program quality, test of programs, process models.

Intended learning outcomes

The students are able to analyse programs, to use testing frameworks and metrics as well as to judge program quality.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IS,ES,GE

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) 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) 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 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)

Module title	Abbreviation
Information Retrieval	10-I=IR-212-m01

Module coordinator	Module offered by
holder of the Chair of Computer Science XII	Institute of Computer Science

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

IR models (e. g. Boolean and vector space model, evaluation), processing of text (tokenising, text properties), data structures (e. g. inverted index), query elements (e. g. query operations, relevance feedback, query languages and paradigms, structured queries), search engine (e. g. architecture, crawling, interfaces, link analysis), methods to support IR (e. g. recommendation systems, text clustering and classification, information extraction).

Intended learning outcomes

The students possess theoretical and practical knowledge in the area of information retrieval and have acquired the technical know-how to create a search engine.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): IT,KI,HCI,GE

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 (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 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
3D User Interfaces			10-HCI=3DUI-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IX		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module will give students the opportunity to learn about the specificities of 3D User Interfaces (3DUI) development 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 techniques. Design guidelines as well as classical and innovative 3D Interaction techniques will be studied. In addition, the course will address novel research themes such as 3D interaction for large displays and games; and integrating 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 video. 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 and https://www.youtube.com/watch?v=gYs-pBW7Agc)

Intended learning outcomes

After the course, the students will gain a solid background on the theory and the methods to create your own 3D spatial interfaces. They will have a broad understanding of the particular difficulties of designing and developing spatial interfaces, as well as evaluating then. Students will also learn about traditional and novel 3D input/output devices (e.g, motion tracking system and Head-mounted Display).

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

V (2) + Ü (2)

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

presentation of project results (approx. 30 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): HCI,GE.

Workload

150 h

Teaching cycle

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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) 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=KT2-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchy, complexity of probabilistic algorithms.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchies, complexity of probabilistic algorithms.

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

V (2) + Ü (2)

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

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

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT, SE, IT, ES

Workload

150 h

Teaching cycle

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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 (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
Artificial Intelligence 1			10-I=KI1-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Intelligent agents, uninformed and heuristic search, constraint problem solving, search with partial information, propositional and predicate logic and inference, knowledge representation.

Intended learning outcomes

The students possess theoretical and practical knowledge about artificial intelligence in the area of agents, search and logic and are able to assess possible applications.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,KI,HCI

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 (2021)
Master's degree (1 major) Aerospace 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) Aerospace Computer Science (2023)
Master's degree (1 major) Quantum Engineering (2024)
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) 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) Information Systems (2025)
Master's degree (1 major) Computer Science (2025)

Module title			Abbreviation
Artificial Intelligence 2			10-I=KI2-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Planning, probabilistic closure and Bayesian networks, utility theory and decidability problems, learning from observations, knowledge while learning, neural networks and statistical learning methods, reinforcement learning, processing of natural language.

Intended learning outcomes

The students possess theoretical and practical knowledge about artificial intelligence in the area of probabilistic closure, learning and language processing and are able to assess possible applications.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,KI,HCI,GE

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 (2021)
Master's degree (1 major) Aerospace 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) Aerospace 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 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) Computer Science (2025)

Module title			Abbreviation
Performance Evaluation of Distributed Systems			10-I=LVS-161-m01
Module coordinator		**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)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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.

Intended learning outcomes

The students possess the methodic knowledge and the practical skills necessary to model technical systems by means of the theory of probability and mathematical statistics.

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

V (4) + Ü (2)

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

written examination (approx. 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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,IT,GE

Workload

240 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 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 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)

Module title			Abbreviation
Mathematical Logic			10-I=ML-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

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

V (2) + Ü (2)

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

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

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,SE,KI,ES

Workload

150 h

Teaching cycle

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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 (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
Medical Informatics			10-I=MI-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Electronic patient folder, coding of medical data, hospital information systems, operation of computers in infirmary and functional units, medical decision making and assistance systems, statistics and data mining in medical research, case-based training systems in medical training.

Intended learning outcomes

The students possess theoretical and practical knowledge about the application of computer science methods in medicine.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IT, KI, HCI, GE

Workload

150 h

Teaching cycle

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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 (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 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
Performance Engineering and Benchmarking of Computer Systems			10-I=PEB-182-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

Introduction to performance engineering of commercial software systems, performance measurement techniques, benchmarking of commercial software systems, modelling for performance prediction, case studies.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of performance metrics, measurement techniques, multi-factorial variance analysis, data analysis with R, benchmark approaches, modelling with queue networks, modelling methods, resource demand approximation, petri nets.

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

V (2) + Ü (2)
Module taught in: English

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

written examination (approx. 90 to 120 minutes)
Language of assessment: English
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

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

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Module appears in

Master's degree (1 major) Satellite Technology (2018)
Module studies (Master) Computer Science (2019)
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)

Module title			Abbreviation
Computer Arithmetic			10-I=RAM-161-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

Spaces of numerical computation, raster and rounding, definition and implementation of computational arithmetic and interval calculation.

Intended learning outcomes

The students possess knowledge about the spaces of numerical computation, raster and roundings, definition and implementation of computational arithmetic and interval calculation. They master the application of algorithms.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,ES

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 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 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)

Module title			Abbreviation
Robotics 1			10-I=RO1-212-m01
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.

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

V (4) + Ü (2)
Module taught in: English

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

written examination (approx. 60 to 90 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).
Separate written examination for Master's students
Language of assessment: English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): KI, ES, LR, HCI, GE

Workload

240 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 (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Information Systems (2022)

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

Module title			Abbreviation
Robotics 2			10-I=RO2-212-m01
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

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, initialising, application examples, problems of Kalman filters, extended Kalman filter.

Intended learning outcomes

The students master all fundamentals that are necessary to understand Kalman filters and their use in applications of robotics. The students possess a knowledge of advanced controller and observer methods and recognise the connections between the dual pairs controllability - observability as well as controller design and observer design. They also recognise the relationship between the Kalman filter as a state estimator and an observer.

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

V (4) + Ü (2)
Module taught in: English

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

written examination (approx. 60 to 90 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: English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): IT, ES, LR

Workload

240 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 (2021)
Master's degree (1 major) Computational Mathematics (2022)
Master's degree (1 major) Mathematics (2022)

Module title			Abbreviation
Discrete Event Simulation			10-I=ST-212-m01
Module coordinator		**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)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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.

Intended learning outcomes

The students possess the methodic knowledge and the practical skills necessary for the stochastic simulation of (technical) systems, the evaluation of results and the correct assessment of the possibilities and limits of simulation methods.

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

V (4) + Ü (2)

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

written examination (approx. 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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): IT,KI,ES,GE

Workload

240 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 (2021)
Master's degree (1 major) Aerospace 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)

Module title			Abbreviation
Principles of Interactive Systems			10-HCI-PRIS-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IX		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The module teaches requirements, concepts and practical solutions for interactive human-computer systems of extended reality (virtual reality, mixed reality, augmented reality), perceptual computing, computer games and cyber-physical systems. Due to their common characteristics, these systems have recently often been referred to as real-time interactive systems.
In the lecture, theoretical models are introduced, requirements of the application domain are derived, and current and novel conceptual and practical solutions are presented. First, conceptual principles for characterizing real-time interactive systems are presented. Then, conceptual models of the mission-critical aspects of time, latencies, processes, and events necessary to describe the behavior of a system are introduced. This is followed by a presentation of the application state, its distribution and coherence requirements, and the consequences of these requirements on decoupling and software quality in general. Then, potential solutions for data redundancy, distribution, synchronization, and interoperability are addressed. Furthermore, concepts underlying virtual reality such as immersion and presence are discussed, as well as various methods for measuring them. Finally, avatars and the concept of embodiment will be discussed. The exercise will provide an insight into practical research work and experiments of the chair as well as a first practical insight into software technologies and frameworks for the creation of interactive real-time systems, e.g. Unity3d and/or Unreal Engine.

Intended learning outcomes

After participating in the module courses, students are able to recognize basic application scenarios for Interactive Systems. They remember subject-specific approaches and can apply them to adequate problems. They know theoretical models and they can summarize, compare and explain different approaches and evaluate their performance. They can apply available tools to typically occurring tasks and know their advantages and disadvantages. Furthermore, you can independently familiarize yourself with complex technical systems as well as independently develop problem-solving proposals, communicate these in a team and integrate them in a prototype.

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

V (2) + Ü (2)
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. 90 minutes) or
b) oral examination of one candidate each (approx. 30 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

Teaching cycle: every semester

Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Human-Computer-Interaction (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Media Entertainment (2022) Master's degree (1 major) Artificial Intelligence & Extended Reality (2024) Master's degree (1 major) Artificial Intelligence (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Mathematics (2024)

Module title			Abbreviation
Software Architecture			10-I=SAR-161-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

Introduction to software architecture, architectural styles and patterns, software metrics, evaluation of architectural styles, software components, interface models and design guidelines, design-by-contract, component-based software engineering, service-oriented architectures, microservice architectures, scalability of databases, cloud-native and serverless computing, continuous integration, continuous delivery, continuous deployment, model-driven architecture

Intended learning outcomes

The students possess a fundamental and applicable knowledge about advanced topics in software engineering with a focus on modern software architectures and fundamental approaches to model-driven software engineering.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IT,ES

Workload

150 h

Teaching cycle

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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 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)

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
Machine Learning (for User Interfaces)			10-HCI=MLUI-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science IX		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us practical speech recognition, effective web search, self-driving cars, and a vastly improved understanding of the human genome. Machine learning is so pervasive today that you probably use it dozens of times a day without knowing it. It is one of today's prominent paradigms in HCI applicable in all areas where the understanding of user input of high variability, specifically for natural interactions using, e.g., gesture, speech, or eye-gaze, is paramount. Many researchers also think it is the best way to make progress towards human-level AI.
In this course, students will learn about the most effective machine learning techniques, and gain practice implementing them and getting them to work. Students not only learn the theoretical underpinnings of learning, but also gain the practical know-how needed to quickly and powerfully apply these techniques to new problems. Finally, they learn about some of Silicon Valley's best practices in innovation as it pertains to machine learning and AI.
This course provides a broad introduction to machine learning, data-mining, and statistical pattern recognition. Topics include: (i) Supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks). (ii) Unsupervised learning (clustering, dimensionality reduction, recommender systems, deep learning). (iii) Best practices in machine learning (bias/variance theory; innovation process in machine learning and AI). The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to building gesture-based and multimodal interfaces, text and speech understanding (web search, anti-spam), smart robots (perception, control), computer vision, medical informatics, audio, database mining, and other areas.

Intended learning outcomes

After the course, the students will be able to solve machine learning tasks on their own using assistive technologies, e.g., like Octave. In addition, they will be able to derive main principles and apply these in own programs. Students will be able to choose the appropriate approach and tools to solve a given machine learning task in various application area, specifically in HCI.

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

V (2) + Ü (2)

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

presentation of project results (approx. 40 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): HCI,GE.

Workload

150 h

Teaching cycle
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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) 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
Visualization of Graphs			10-I=VG-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This course covers the most important algorithms to draw graphs. Methods from the course *Algorithmische Graphentheorie* (*Algorithmic Graph Theory*) such as divide and conquer, flow networks, integer programming and the planar separator theorem will be used. We will become familiar with measures of quality of a graph drawing as well as algorithms to optimise these measures.

Intended learning outcomes

The participants get an overview of graph visualisation and become familiar with typical tools. They consolidate their knowledge about the modelling and solving of problems with the help of graphs and graph algorithms.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,IT,HCI,GE

Workload

150 h

Teaching cycle

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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 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 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)

Module title			Abbreviation
Selected Topics in Algorithms			10-I=AKA-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in algorithmics.

Intended learning outcomes

The students understand the basic approach of algorithmic computer science. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):
AT

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) 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)

Module title			Abbreviation
Selected Topics in Theory			10-I=AKT-161-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science I		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Selected topics in theory.

Intended learning outcomes

The students understand the basic approach of theoretical computer science. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):
AT

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) 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)

Module title			Abbreviation
Security of Software Systems			10-I=SSS-212-m01
Module coordinator		**Module offered by**	
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 semester	graduate	--	

Contents

The lecture provides an overview of common software vulnerabilities, state-of-the-art attack techniques on modern computer systems, as well as the measures implemented to protect against these attacks. In the course, the following topics are discussed:

- x86-64 instruction set architecture and assembly language
- Runtime attacks (code injection, code reuse, defenses)
- Web security
- Blockchains and smart contracts
- Side-channel attacks
- Hardware security

Intended learning outcomes

Students gain a deep understanding of software security, from hardware and low-level attacks to modern concepts such as blockchains. The lecture prepares for research in the area of security and privacy, while the exercises allow students to gain hands-on experience with attacks and analysis of systems from an attacker's perspective.

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

V (2) + Ü (2)
Module taught in: English

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

written examination (approx. 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: English
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, KI, LR, HCI, ES, SEC

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 (2021)

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

Module title			Abbreviation
Machine Learning for Natural Language Processing			10-I=NLP-212-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science X		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The lecture conveys advanced knowledge about methods in computational text processing. To this end, it presents state of the art models and techniques in the area of machine learning, as well as their technical background, 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 Embeddings, are presented. Starting from this we cover, among others, models from the area of Deep Learning, like 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.

Intended learning outcomes

The participants have solid knowledge on problems and methods in the area of computational text processing and are able to identify and apply suitable methods for a specific task.

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

V (2) + Ü (2)

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

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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT,KI,HCI

Workload

150 h

Teaching cycle

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

§ 22 II Nr. 3 b)

Module appears in

Module studies (Master) Computer Science (2019)
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) Mathematical Data Science (2025)
Master's degree (1 major) Economathematics (2025)

Module title			Abbreviation
Professional Project Management			10-I=PM-212-m01
Module coordinator		**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 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; 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/SCRUM, combination of classic and agile 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 (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. 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
creditable for bonus

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE,IT,KI,ES,LR,HCI,GE

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 (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) Management (2022)

Master's degree (1 major) Media Entertainment (2022)
Master's degree (1 major) Psychology of digital media (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)

Module title			Abbreviation
Project - Current Topics in Computer Science			10-I=PRJAK-212-m01
Module coordinator		**Module offered by**	
Dean of Studies Informatik (Computer Science)		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Completion of a project task (in Teams).

Intended learning outcomes

The project allows participants to work on a problem in computer science in teams.

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

P (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)

project report (10 to 15 pages) and presentation of project (15 to 30 minutes)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered (Each project is offered one time only. The project will not be repeated; there will not be another project with the same topic. Assessment can, therefore, only be offered for the project offered in the respective semester)

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT, SE, IT, KI, ES, LR, HCI, GE

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 (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) Management (2022)
Master's degree (1 major) Media Entertainment (2022)
Master's degree (1 major) Psychology of digital media (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)

Module title			Abbreviation
NLP and Text Mining			10-I=STM-162-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science VI		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Foundations in the following areas: definition of NLP and text mining, properties of text, sentence boundary detection, tokenisation, collocation, N-gram models, morphology, hidden Markov models for tagging, probabilistic 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.

Intended learning outcomes

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.

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

V (2) + Ü (2)

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

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

Allocation of places

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Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): AT, IT, HCI.

Workload

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) 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) 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 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
Statistical Network Analysis			10-I=SNA-222-m01
Module coordinator		**Module offered by**	
holder of the Chair of Computer Science XV		Institute of Computer Science	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Networks matter! This holds for technical infrastructures like communication or transportation networks, for information systems and social media in the World Wide Web, but also for various social, economic and biological systems. What can we learn from data that capture the interaction topology of such complex systems? What is the role of individual nodes and how can we discover significant patterns in the structure of networks? How do these structures influence dynamical process like diffusion or the spreading of epidemics? Which are the most influential actors in a social network? And how can we analyze time series data on systems with dynamic network topologies?
Addressing those questions, the course combines a series of lectures -- which introduce fundamental concepts for the statistical modelling of complex networks -- with weekly exercises that show how we can apply them to practical network analysis tasks. Topics covered include foundations of graph theory, centrality and modularity measures, aggregate statistical characteristics of large networks, random graphs and statistical ensembles of complex networks, generating function analysis of expected graph properties, scale-free networks, stochastic dynamics in networks, spectral analysis, as well as the modelling of time-varying networks. The course material consists of annotated slides for lectures as well as a accompanying git-Repository of jupyter notebooks, which implement and validate the theoretical concepts covered in the lectures. Students can test and deepen their knowledge through weekly exercise sheets. The successful completion of the course requires to pass a final written exam.

Intended learning outcomes

The course will equip participants with statistical network analysis techniques that are needed for the data-driven modelling of complex technical, social, and biological systems. Students will understand how we can quantitatively model the topology of networked systems and how we can detect and characterize topological patterns. Participants will learn how to use analytical methods to make statements about the expected properties of very large networks that are generated based on different stochastic models. They further gain an analytical understanding of how the structure of networks shapes dynamical processes, how statistical fluctuations in degree distributions influence the robustness of systems, and how emergent network features emerge from simple random processes.

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

V (2) + Ü (2)
Module taught in: English

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

written examination (approx. 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: English
creditable for bonus

Allocation of places

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Additional information

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Workload
150 h
Teaching cycle
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

Application Subject Physik

(ECTS credits)

Module title			Abbreviation
Image and Signal Processing in Physics			11-BSV-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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

Intended learning outcomes

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

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

V (2) + Ü (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

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) Nanostructure Technology (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
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Master's degree (1 major) Mathematics (2019)
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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
Physics of Advanced Materials			11-PMM-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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

Intended learning outcomes

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

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) 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)

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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
Spintronics	11-SPI-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Applied Physics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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

Intended learning outcomes

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

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
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d) project report (approx. 8 to 10 pages) or
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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)
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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 State Spectrocopy			11-FKS-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Single- and many-particle pictures of electrons in solids, light-matter interaction, optical spectroscopy, electron microscopy, X-ray spectroscopy.

Intended learning outcomes

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

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes)
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) Nanostructure Technology (2016)
Master's degree (1 major) Computational Mathematics (2016)
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exchange program Physics (2023)
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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			11-MAG-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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

Intended learning outcomes

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

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

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
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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) Nanostructure Technology (2016)

Master's degree (1 major) Computational Mathematics (2016)
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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
Optical Properties of Semiconductor Nanostructures			11-HNS-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Semiconductor nanostructures are frequently referred to as "artificial materials". In contrast to atoms, molecules or macroscopic crystals, their electronic, optical and magnetic properties can be systematically tailored by changing their size. The lecture addresses technological challenges in the preparation of semiconductor nanostructures of varying dimensions (2D, 1D, 0D). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.

Intended learning outcomes

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

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) Nanostructure Technology (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's degree (1 major) Functional Materials (2016)
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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)
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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
Methods of Observational Astronomy	11-ASM-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Methods of observational astronomy across the electromagnetic spectrum. Evaluation of observational data from radio, optical, X-ray and gamma-ray telescopes.

Intended learning outcomes

Overview of the methods used in observational astronomy in various parts of the electromagnetic spectrum (radio, optical, X-ray and gamma-ray energies). Knowledge of principles and applications of these methods and ability to conduct astronomical observations.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
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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)
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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)
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Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
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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**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Physics with modern particle detectors at the LHC and at the Tevatron. Discovery of the Higgs boson. Search for supersymmetry and other physics beyond the standard model. Determination of the top quark mass and W mass as well as other parameters of the standard model. Introduction to modern methods of analysis and assessment of systematic errors.

Intended learning outcomes

The students are familiar with the principles of modern particle detector physics, especially with currently open questions of Particle Physics, which are examined by using these detectors. They know modern methods of analysis and are able to put results into context and to assess their systematic uncertainties.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
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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) Computational Mathematics (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
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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-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Overview
2. Dynamics of charged particles in magnetic and electric fields
3. Elements of space physics
4. The sun and heliosphere
5. Acceleration and transport of energetic particles in the heliosphere
6. Instruments to measure energetic particles in extraterrestrial space

Intended learning outcomes

The students acquire basic knowledge of Space Physics, in particular regarding the characterisation of the dynamics of charged particles in space and the heliosphere. They know relevant parameters and theoretical concepts and corresponding measuring methods.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
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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)
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Master's degree (1 major) Computational Mathematics (2016)
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Master's degree (1 major) Physics (2020)
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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-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Phenomenology of active galactic nuclei and extragalactic jets
2. Jet-emission processes
3. VLBI observations of jets
4. High-energy observations of jets
5. Multimessenger signatures of jets

Intended learning outcomes

The students acquire knowledge of multiwavelength astronomy by studying the observations of active galactic nuclei and their extragalactic jets. They gain insights into a special, not yet solved astrophysical question and practice writing an observational proposal.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
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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)
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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 Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

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

Intended learning outcomes

The students acquire in-depth knowledge of advanced quantum mechanics. This knowledge is highly relevant to most of the theoretical Master's degree courses in Astrophysics, Particle Physics and Condensed Matter Physics. The completion of this course is highly recommended.

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
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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) 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
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Mathematical Foundations
2. Differential forms
3. Brief Summary of the special relativity
4. Elements of differential geometry
5. Electrodynamics as an example of a relativistic gauge theory
6. Field equations of the fundamental structure of general relativity
7. Stellar equilibrium and other astrophysical applications
8. Introduction to cosmology

Intended learning outcomes

The students become familiar with the principal physical and mathematical concepts of general relativity. The main topics include modern formulation on the basis of differential forms. Furthermore, the similarities between electrodynamics as a gauge theory and general relativity are emphasised. The students learn to apply the theory to simple models of stellar equilibrium and are introduced to basic elements of cosmology.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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
Physics of Complex Systems	11-PKS-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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

Intended learning outcomes

The students acquire in-depth knowledge of a wide variety of concepts and methods essential for a thorough understanding of cooperative phenomena in complex many-particle systems. The main focus includes a thorough understanding of the concepts of entropy, entropy production and universality. The students are prepared for research activities in different areas of physics of complex systems.

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

V (2) + 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

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)
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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 Solid State Physics			11-TFK-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

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 topological insulators (TIs), bulk-surface correspondence, general properties of TIs)
2 Electron-electron interactions in solids (path integral method for weakly interacting fermions, mean field theory, random phase approximation (RPA), density functional theory)
3 Application of mean field theory and the RPA to magnetism
4 BCS theory of superconductivity

Intended learning outcomes

During the two-semester lecture, the students acquire a basic understanding of many topics of Solid-State Physics, which are addressed in classical textbooks, and thereby advance their knowledge of the underlying concepts and the methods of description. The course builds upon the courses "Experimental Condensed Matter Physics" and "Quantum Mechanics".

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

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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) 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
Theoretical Solid State Physics 2	11-TFK2-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

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)

Intended learning outcomes

During the two-semester lecture, the students acquire a basic understanding of many topics of Solid-State Physics, which are addressed in classical textbooks, and thereby advance their knowledge of the underlying concepts and the methods of description. The course builds upon the courses "Experimental Condensed Matter Physics" and "Quantum Mechanics".

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

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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
Computational Materials Science (DFT)	11-CMS-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Density functional theory (DFT)
2. Wannier functions and localized basis functions
3. Numerical evaluation of topological invariants
4. Hartree-Fock and static mean-field theory
5. Many-body methods for solid state physics
6. Anderson impurity model (AIM) and Kondo physics
7. Dynamical mean-field theory (DMFT)
8. DFT + DMFT methods for realistic modeling of solids
9. Strongly correlated electrons

Intended learning outcomes

Aside from the theoretical discussion of these topics, the students carry out hands-on exercises from the CIP pool. The participants are introduced to the use of DFT software packages such as VASP or Wien2k and to the construction of maximally localised Wannier functions through the projection of DFT results on atom orbitals with the software wannier90. Furthermore, the students learn how to construct many-particle solutions of AIM and observe border cases such as the Kondo regime. Impurity solvers such as exact diagonalisation or continuous-time quantum Monte Carlo are utilised to solve the self consistency equations of dynamic molecular field theory (DMFT). These steps are necessary to reach the peak of the lecture: a DFT-DMFT calculation of a strongly correlated transition metal oxide such as SrVO3.

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
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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 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)

Module title			Abbreviation
Conformal Field Theory			11-KFT-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Conformal field theory (CFT) was developed in the 1980s and found immediate application in string theory and two-dimensional statistical mechanics, where critical exponents and correlation functions for many models (Ising, tricritical Ising, 3-state Potts, etc.) could be exactly calculated. The physical idea is that the principle of scale invariance is elevated from a global to a local invariance, which, for reasons of consistency, amounts to invariance under conformal transformations. This, in turn, yields a rich and fascinating mathematical structure for two dimensional systems (either two space dimensions or one time and one space dimension). CFT has become relevant to many interesting areas of condensed matter physics, including Abelian and non-Abelian bosonisation, quantised Hall states (where the bulk wave function is described in terms of conformal correlators, and the edge in terms of 1+1 dimensional CFTs), the two-channel Kondo effect, fractional topological insulators, and in particular fault-tolerant topological quantum computers involving non-Abelian anyons (Ising and Fibonacci anyons, for example, owe their names to the fusion rules of the associated conformal fields.) A potential syllabus for the first term of the course is:

0. Introduction (scale and conformal invariance, critical exponents, the transverse Ising model at the self-dual point)
1. Conformal theories in D dimensions (conformal group, conformal algebra in 2D, constraints on correlation functions)
2. Conformal theories in D=2 (primary fields and correlation functions, quantum field theory, canonical quantisation and Noether's theorem, radial quantisation and Polyakov's theorem, time ordering and functional integration, the free boson and vertex operators, conformal Ward identities)
3. Central charge and Virasoro algebra (central charge, the Schwarzian derivative, free fermion, (Abelian) bosonisation, mode expansions and Virasoro algebra, cylinder geometry and Casimir effect, in- and out-states, highest weight states, descendant fields and operator product expansions, conformal blocks, duality and bootstrap)
4. Kac determinant and unitarity (Verma modules and null states, Kac determinant formula, non-unitarity proof, conformal grids, minimal models in general).

Intended learning outcomes

The students acquire practical and conceptional familiarity with the methods of conformal field theory. As the completion of "Quantum Mechanics II" (11-QM2) is the only prerequisite to take part in this course, the students also acquire basic knowledge of critical phenomena, quantum field theory and functional integrals. The course is primarily addressed to students of Theoretical Physics and aims to increase their general level of knowledge by becoming acquainted with a sophisticated subdiscipline with applications in many subdisciplines of Condensed Matter Physics.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or

e) presentation/talk (approx. 30 minutes).
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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
Conformal Field Theory 2	11-KFT2-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

5. Minimal models (critical statistical mechanics models (Ising, tricritical Ising, 3 state Potts model, restricted solid-on-solid models), correlation functions of the critical Ising model, fusion rules and Verlinde algebra, Landau-Ginzburg description of minimal models, modified Coulomb gas method and its application to the Ising model, superconformal models)
6. Free bosons and fermions (mode expansions, twist fields, fermionic zero modes and fermion parity)
7. Free fermions on the torus (operator implementation of the partition function, vacuum energies, representations of Virasoro algebra, modular group and fermionic spin structures, Virasoro characters, critical Ising model on the torus, Jacobi theta function identities)
8. Free bosons on the torus (Lagrangian formulation of the partition function, fermionisation, orbifolds in general, S1/Z2 orbifold, Gaussian and Askhin-Teller models, duality between original and orbifold theories, marginal operators, the space of c=1 theories)

Intended learning outcomes

The students acquire practical and conceptional familiarity with the methods of conformal field theory. As the completion of "Quantum Mechanics II" (11-QM2) is the only prerequisite to take part in this course, the students also acquire basic knowledge of critical phenomena, quantum field theory and functional integrals. The course is primarily addressed to students of Theoretical Physics and aims to increase their general level of knowledge by becoming acquainted with a sophisticated subdiscipline with applications in many subdisciplines of Condensed Matter Physics.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
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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
--
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
Renormalization Group and Critical Phenomena	11-CRP-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	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 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 (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

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)
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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 by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1.Instability of Fermi systems in one dimension (1D)
2.Abelian bosonisation and Luttinger liquids (spinless fermions, correlation functions, models with spin, renormalization group, and the sine-Gordon model).

The below mentioned topics will be presented in different years:
3.Interacting fermions on a lattice (Hubbard model, t/J model, transport properties)
4.Bethe ansatz
5.Spin-1/2 chains
6.Disordered systems
7.Non-abelian bosonisation and the WZW model (Kac-Moody algebras, Sugawara construction, Knizhnik-Zamolodchikov equation, applications of the WZW model)

Intended learning outcomes

The students become familiar with the peculiarities of one-dimensional (1D) electron systems and acquire the theoretical tools to understand phenomena relevant to experiments, including disorder effects and transport in 1D.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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
Introduction to Gauge/Gravity Duality	11-GGD-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Elements of quantum field theory:
   - Quantisation of the free field
   - Interactions
   - Renormalisation Group
   - Gauge Fields
   - Conformal Symmetry
   - Large N expansion
   - Supersymmetry
2. Elements of gravity
   - Manifolds, coordinate covariance and metric
   - Riemann curvature
   - Maximally symmetric spacetimes
   - Black holes
3. Elements of string theory
   - Open and closed strings
   - Strings in background fields
   - Type IIB String Theory
   - D-Branes
4. The AdS/CFT correspondence
   - Statement of the correspondence
   - Near-horizon limit of D3-Branes
   - Field-operator correspondence
   - Tests of the correspondence: Correlation functions
   - Tests of the correspondence: Conformal anomaly
   - Holographic principle
5. Extensions to non-conformal theories
   - Holographic renormalisation group
   - Holographic C-Theorem
6. Applications I: Thermo- and hydrodynamics
   - Quantum field theory at finite temperature
   - Black holes
   - Holographic linear response formalism
   - Transport coefficients: Shear viscosity and conductivities
7. Applications II: Condensed matter physics
   - Finite charge density and Reissner-Nordström black holes
   - Quantum critical behaviour
   - Holographic fermions
   - Holographic superconductors
   - Entanglement entropy
8. Applications III: Particle physics
   - Gravity dual of confinement
   - Gravity dual of chiral symmetry breaking
   - Quark-gluon plasma

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

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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)
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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
Cosmology	11-AKM-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	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 clusters, intergalactic medium, cosmological parameters.

Intended learning outcomes

The students have basic knowledge of cosmology. They know the theoretical methods of cosmology and are able to relate them to observations. They have gained insights into current research topics and are able to process scientific questions.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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)
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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 offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Topics in theoretical astrophysics such as e.g. white dwarfs, neutron stars and black holes, supernovae, pulsars, accretion and jets, shock waves, radiation transport, and gravitational lensing

Intended learning outcomes

Knowledge of basic processes and methods of Theoretical Astrophysics. Ability to formulate theoretical models.

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

V (2) + 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

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)
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Master's degree (1 major) Physics (2020)
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Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
Master's degree (1 major) Mathematical Physics (2020)
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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
High Energy Astrophysics			11-APL-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Radiative processes, interaction of light with matter, particle acceleration processes, pair creation, nuclear processes, pion production, astrophysical shock waves, kinetic equations

Intended learning outcomes

The student gains knowledge in fundamentals of High-Energy Astrophysics, such as particle acceleration and non-thermal radiative processes in astrophysical objects

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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

--

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)

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Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
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Master's degree (1 major) Computational Mathematics (2022)
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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 Field Theory II			11-QFT2-161-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

1. Generating Functionals
2. Path Integrals
3. Renormalization
4. Renormalization group
5. Gauge theories
6. Spontaneous Symmetry Breaking
7. Effective Field Theory (optional)

Intended learning outcomes

The students have advanced knowledge of the methods and concepts of quantum field theory. They have mastered the principles, especially of renormalisation and gauge theories. They are able to formulate and solve problems of quantum field theory by using the acquired calculation methods.

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

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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)
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Master's degree (1 major) Computational Mathematics (2016)
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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 Elementary Particle Physics	11-TEP-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Fundamental particles and forces
2. Symmetries and groups
3. Quark model of hadrons
4. Quark parton model and deep inelastic scattering
5. Principles of quantum field theory
6. Gauge theories
7. Spontaneous symmetry breaking
8. Electroweak standard model
9. Quantum chrome dynamics
10. Extensions of the standard model.

Intended learning outcomes

The students are familiar with the mathematical methods of Elementary Particle Physics. They understand the structure of the standard model based on symmetry principles and experimental observations. They know calculation methods for the processing of simple problems and processes of Elementary Particle Physics. Furthermore, they know the tests and limits of the standard model and the basics of extended theories.

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
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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
Selected Topics of Theoretical Elementary Particle Physics	11-ATTP-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

A selection of topics from the following fields will be covered in different years:
1. Advanced techniques for precision calculations of scattering amplitudes
2. Phenomenology of particle accelerators
3. Higgs physics
4. Top quark physics

Intended learning outcomes

The students are familiar with the tests and limits of the standard model of Particle Physics, Higgs physics and neutrino physics. They are able to formulate extensions of the standard model. Furthermore, they know how to test these extensions in low energy experiments, at high energy colliders and in cosmology.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
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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)
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 Beyond the Standard Model of Elementary Particle Physics	11-BSM-161-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Principles of the standard model of Elementary Particle Physics
2. Tests of the standard model in low energy experiments and at high energy colliders
3. Neutrino physics
4. Higgs physics.

In addition, a selection of topics from the following fields will be covered in different years:

- Phenomenology of experiments at the LHC,
- particle cosmology,
- extended gauge theories,
- models with extended Higgs sectors,
- supersymmetry,
- models with additional space-time dimensions

Intended learning outcomes

The students are familiar with the tests and limits of the standard model of Particle Physics, Higgs physics and neutrino physics. They are able to formulate extensions of the standard model. Furthermore, they know how to test these extensions in low energy experiments, at high energy colliders and in cosmology.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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
Solid State Physics 2			11-FK2-201-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
8	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	Approval from examination committee required.	

Contents

1. Electrons in a periodic potential - the band structure
a. Electrical and thermal transport
b. Bloch theorem
c. Electrons
2. Semi-classical models of dynamic processes
a. Electrical transport in partially and completely filled bands
b. Fermi surfaces; measurement techniques
c. Electrical transport in external magnetic fields
d. Boltzmann-equations of transport
3. The dielectric function and ferroelectrics
a. Macroscopic electrodynamics and microscopic theory
b. Polarizability of solids, of lattices, of valence electrons and quasi-free electrons; optical phonons, polaritons, plasmons, inter-band transitions, Wannier-Mott excitons
c. Ferromagnetism
4. Semiconductors
a. Characteristics
b. Intrinsic semiconductors
c. Doped semiconductors
d. Physics and applications of p-n junctions
e. Heterostructures
5. Magnetism
a. Atomic dia- and paramagnetism
b. Dia- and paramagnetism in metals
c. Ferromagnetism
6. Superconductivity
a. Phenomena
b. Models of superconductivity
c. Tunnel experiments und applications

Intended learning outcomes

Knowledge of effects, concepts and models in advanced solid state physics. Familiarity with the theoretical principles and with applications of experimental methods.

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

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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) 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
Semiconductor Physics			11-HPH-201-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

The lecture deals with the fundamental properties of semiconductors. It begins with an analysis of the crystal structure, leading to methods for describing band structures. These form a basis for discussing optical and electronic properties of monolithic semiconductors. It then turns to examining semiconductor heterostructures, and studies how these can be used to modify and design optical and electrical properties, especially in the case of lowered dimensionality systems. Examples are selected from current research activities.

Intended learning outcomes

To provide the student with a working knowledge semiconductors pertaining to crystal structure, symmetries, and band structures, as well as electrical and optical properties. This establishes a solid basis preparing him for the more targeted specially lectures in the program.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) 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
Field Theory in Solid State Physics	11-FFK-201-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions
An outline could be:
1. Single-particle Green's function
2. Review of second quantization
3. Diagrammatic method using many particle Green's functions at temperature T=0
4. Diagrammatic method for finite T
5. Landau theory of Fermi liquids
6. Superconductivity
7. One-dimensional systems and bosonization

Intended learning outcomes

Working knowledge of the methods of quantum field theory in a non-relativistic context. Ability to study properties of Fermi liquids (and bosonic systems) beyond the one-particle picture. Acquisition of methods which are essential for the understanding the effects of interactions, including superconductivity and the Kondo effect.

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

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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) 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
Advanced Theory of Quantum Computing and Quantum Information	11-QIC-201-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Brief summary of classical information theory
2. Quantum theory seen from the perspective of information theory
3. Composite systems and the Schmidt decomposition
4. Entanglement measures
5. Quantum operations, POVMs, and the theorems of Kraus and Stinespring
6. Quantum gates and quantum computers
7. Elements of the theory of decoherence

Intended learning outcomes

Comprehensive understanding of quantum states and identity matrix beyond the usual textbook interpretation. Knowledge of handling tensor products and dealing with quantum effects in multipartite quantum systems. In-depth understanding of the phenomenon of entanglement. Knowledge of the fundamental mathematical concepts of quantum information theory. Ability to assess the limitations of quantum computing arising from decoherence.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) 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
Topological Effects in Solid State Physics	11-TEFK-201-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

1. Geometric phase in quantum systems
2. Mathematical basics of topology
3. Time-reversal symmetry
4. Hall conductance and Chern numbers
5. Bulk-boundary correspondence
6. Graphene (as a topological insulator)
7. Quantum Spin Hall insulators
8. Z2 invariants
9. Topological superconductors

Intended learning outcomes

In-depth theoretical understanding of the topological concepts in quantum physics related to solid state systems. Ability to connect their knowledge with different research activities at the Department of Physics and Astronomy at Würzburg University.

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

V (4) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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

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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) 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
Phenomenology and Theory of Superconductivity	11-PTS-201-m01

Module coordinator	Module offered by
Managing Director of the Institute of Applied Physics and Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
6	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

Basic Properties of Superconductors and their Applications, Development of technological platforms, Methods of material science for calculating temperature profiles in superconductors. Overview of the phenomenology of conventional and unconventional superconductivity. Review of BCS theory and its applicability for different types of superconductors. Extension of Ginzburg-Landau theory to a quantum field theory formalism using Feynman diagrams and functional integrals. Theoretical formalism of Ward identities and response functions. Goldstone modes, phase fluctuations, and coupling to the electromagnetic field. Interpretation of the Meissner effect in terms of the Higgs mechanism. Interplay of magnetism and conventional/unconventional superconductivity. Discussion of current research topics and perspective on room-temperature superconductivity.

Intended learning outcomes

Acquisition of basic knowledge about superconductivity as a macroscopic quantum phenomenon. Profound understanding of unconventional superconductivity and its interplay with magnetism in the context of current research. Knowledge of BCS mean-field theory, the quantum-field theory methods necessary to extend BCS theory, as well as the Meissner effect and the Higgs mechanism. Basic understanding of unconventional superconductors and their fascinating connection with competing magnetic phases.

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

V (3) + R (1)
Module taught in: German or English

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

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method 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) 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
Quantum Field Theory I	11-QFT1-201-m01

Module coordinator	Module offered by
Managing Director of the Institute of Theoretical Physics and Astrophysics	Faculty of Physics and Astronomy

ECTS	Method of grading	Only after succ. compl. of module(s)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	Approval from examination committee required.

Contents

1. Symmetries.
2. Lagrange formalism for fields.
3. Field quantisation.
4. Asymptotic states, scattering theory and S-matrix
5. Gauge principle and interaction.
6. Perturbation theory.
7. Feynman rules.
8. Quantum elektrodynamical processees in Born approximation.
9. Radiative corrections (optional)
10. Renormalisation (optional).

Intended learning outcomes

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 processes in the framework of quantum electrodynamics in leading order. Moreover, they have a basic understanding of radiative corrections and renormalisation.

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
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Master's degree (1 major) Physics (2020) Master's 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)

Internship

(ECTS credits)

Module title			Abbreviation
Internship Mathematics			10-M=EPRK-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	In advance, please consult with a lecturer who agrees to be your supervisor.	

Contents

Work placement in economy, industry, research or administration.

Intended learning outcomes

The student applies his/her skills obtained during his/her studies in the master programme to a specific practical problem in research, economy or industry.

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

P (0)

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) placement report (15 to 30 pages) or
b) talk (30 to 60 minutes)

Allocation of places

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Additional information

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Workload

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

Thesis

(30 ECTS credits)

Module title			Abbreviation
Master Thesis Mathematics			10-M=MAAR-161-m01
Module coordinator		**Module offered by**	
Dean of Studies Mathematik (Mathematics)		Institute of Mathematics	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	The supervisor may make the successful completion of certain modules that are relevant for the respective topic a prerequisite for the assignment of the topic.	

Contents

Independently researching and writing on a topic in mathematics selected in consultation with the supervisor.

Intended learning outcomes

The student is able to work independently on a given mathematical topic and apply the skills and methods obtained during his/her studies in the master programme. He/She can write down the result of his/her work in a suitable form.

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

No courses assigned to module

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

Master's thesis (750 to 900 hours total)
Registration and assignment of topic in consultation with supervisor.
Language of assessment: German or English

Allocation of places

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Additional information

Time to complete: 6 months

Workload

900 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) Mathematics (2019)
Master's degree (1 major) Mathematics (2022)
Master's degree (1 major) Mathematics (2024)