Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Module Catalogue

for the Subject

Computational Mathematics

as a Bachelor's with 1 major

with the degree "Bachelor of Science"

(180 ECTS credits)

Examination regulations version: 2015
Responsible: Faculty of Mathematics and Computer Science
Responsible: Institute of Mathematics

Contents

The subject is divided into

Learning Outcomes

German contents and learning outcome available but not translated yet.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen sind vertraut mit den Arbeitsweisen und der zugehörigen Fachsprache der Mathematik und beherrschen die Methoden mathematischen Denkens und Beweisens.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse der Numerischen Mathematik, der mathematischen Modellierung und des Wissenschaftlichen Rechnens und können sicher mit den Methoden umgehen.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse weiterer Gebiete der Mathematik und sind vertraut mit den grundlegenden Beweismethoden dieser Gebiete.
- Die Absolventinnen und Absolventen kennen die grundlegenden Denkweisen und Arbeitstechniken eines weiteren Fachs aus dem Bereich der Naturwissenschaften und der Informatik.
- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, sich selbständig mithilfe von Fachliteratur in weitere Gebiete der Mathematik einzuarbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen verständlich zu präsentieren.
- Die Absolventinnen und Absolventen besitzen die für ein weiterführendes, insbesondere Master-Studium, erforderlichen Grundkenntnisse, Denk- und Arbeitsweisen und Methodenkenntnisse.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie in ihrer eigenen Arbeit zu beachten.

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen zielgruppenorientiert verständlich zu formulieren und zu präsentieren.
- Die Absolventinnen und Absolventen sind in der Lage, konkrete Probleme aus anderen Gebieten zu erkennen, zu strukturieren, zu modellieren und mit mathematischen Methoden Lösungswege zu entwickeln.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in Teams zu arbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, sich weitere Wissensgebiete selbständig, effizient und systematisch zu erschließen.
- Die Absolventinnen und Absolventen sind vertraut mit mindestens einer modernen Programmiersprache und können sicher mit mathematischer Software umgehen.
- Die Absolventinnen und Absolventen besitzen die Fähigkeit, in interdisziplinär zusammengesetzten Teams im Bereich der Informatik und Naturwissenschaften gestaltend mitzuwirken.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.

- Die Absolventinnen und Absolventen sind in der Lage, gesellschaftliche, wirtschaftliche und historische Entwicklungen und Prozesse kritisch zu reflektieren und zu bewerten.
- 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, Ideen und Lösungsvorschläge allgemeinverständlich zu formulieren und 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)):

03-Aug-2015 (2015-75)

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

Compulsory Courses

(55 ECTS credits)

Module title			Abbreviation
Overview Analysis for Computational Mathematics			10-M-ANC-Ü-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)**	
13	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Real numbers and completeness, basic topological notions, convergence and divergence of sequences and series, differential and integral calculus in one variable, further topological considerations, differential calculus with a focus on functions in several variables.

Intended learning outcomes

The student knows and masters the essential methods and proof techniques of analysis and is able to apply them independently, He/She has an overview over the fundamental notions and concepts of analysis, their analytic background and geometric interpretation, and can interconnect them and express them adequately in written and oral form.

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

V (4) + Ü (2)

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

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-ANA1 and 10-M-ANA2.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

390 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) Computational Mathematics (2015)

Module title			Abbreviation
Overview Linear Algebra for Computational Mathematics			10-M-LNC-Ü-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)**	
13	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic notions and structures; vector spaces, linear maps and systems of linear equations; theory of matrices and determinants; eigenvalue theory; bilinear forms and Euclidean/unitary vector spaces; diagonalisability and Jordan normal form.

Intended learning outcomes

The student knows and masters the essential methods and proof techniques of linear algebra and is able to apply them independently. He/She has an overview over the fundamental notions and methods of linear algebra, knows about their algebraic and geometric background, is able to relate them to each other and can present them adequately in written and oral form.

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

V (4) + Ü (2)

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

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-LNA1 and 10-M-LNA2.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

390 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) Computational Mathematics (2015)

Module title			Abbreviation
Seminar Mathematics			10-M-SEM-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	undergraduate	--	

Contents

A selected topic in mathematics.

Intended learning outcomes

The student gains first experience with independent scientific work. He/She masters elaboration and structuring of a given topic using selected literature, and prepares a talk on the subject. He/She is able to participate actively in a scientific discussion.

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

S (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)

talk (60 to 120 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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Advanced Analysis			10-M-VAN-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)
7	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Continuation of analysis in several variables, integration theorems.

Intended learning outcomes

The student is acquainted with advanced topics in analysis. Taking the example of the Lesbegue integral, he or she is able to understand the construction of a complex mathematical concept.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

210 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Physics (2016)
Master's degree (1 major) Nanostructure Technology (2016)
Master's degree (1 major) Nanostructure Technology (2020)
Master's degree (1 major) Physics (2020)
Master's degree (1 major) Physics International (2020)
Master's degree (1 major) Quantum Engineering (2020)
Master's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Numerical Mathematics 1			10-M-NUM1-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in numerical mathematics, applies them to practical problems and knows about their typical fields of application.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Modeling and Computational Science	10-M-MWR-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)
8	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Aspects of mathematical modelling of technical or scientific processes. Basic principles of modelling, aspects of scaling the modelling, asymptotic series, classical methods for solving ordinary and partial differential equations, fundamental methods for numerical solution of partial differential equations and the resulting systems of linear equations.

Intended learning outcomes

The student masters the fundamental mathematical methods and techniques to simulate processes from natural and engineering sciences on a computer.

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

V (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 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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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

Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Functional Materials (2016)
Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)

Compulsory Electives Computational Mathematics

(49 ECTS credits)

Subfield Basics of Analysis

(8 ECTS credits)

Module title			Abbreviation
Analysis 1			10-M-ANA1-152-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)**	
8	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Real numbers and completeness; basic topological notions; convergence and divergence of sequences and series; power series and Taylor series; basics in differential calculus in one variable; basics of integral calculus in one variable (Riemann integral and improper integral).

Intended learning outcomes

The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form.

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

V (4) + Ü (2)

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

written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Economathematics (2021)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Analysis 2			10-M-ANA2-152-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)**	
8	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Further topological considerations, basics in differential calculus in several variables, inverse function theorem, implicit function theorem.

Intended learning outcomes

The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form.

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

V (4) + Ü (2)

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

written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Subfield Basics of Linear Algebra

(8 ECTS credits)

Module title			Abbreviation
Linear Algebra 1			10-M-LNA1-152-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)**	
8	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic notions and structures; vector spaces, linear maps, systems of linear equations; theory of matrices and determinants.

Intended learning outcomes

The student knows and masters the basic notions and essential methods of linear algebra. He/She is acquainted with the central proof methods in linear algebra and can apply them to solve easy problems. He/She is able to perform simple mathematical arguments independently, and can present them adequately in written form.

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

V (4) + Ü (2)

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

written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Economathematics (2021)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Linear Algebra 2			10-M-LNA2-152-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)**	
8	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Eigenvalue theory, bilinear forms, Euclidean and unitary vector spaces, diagonalisation and Jordan normal form.

Intended learning outcomes

The student knows and masters the basic notions and essential methods of linear algebra. He/She is acquainted with the central proof methods in linear algebra and can apply them to solve easy problems. He/She is able to perform simple mathematical arguments independently, and can present them adequately in written form.

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

V (4) + Ü (2)

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

written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each)
Language of assessment: German and/or English

Allocation of places

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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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Subfield Overview Numerical Mathematics and Modelling

(12 ECTS credits)

Module title			Abbreviation
Overview Numerical Mathematics 1 and 2 for Computational Mathematics			10-M-NUC-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration.

Intended learning outcomes

The student is acquainted with fundamental and advanced concepts and methods in numerical mathematics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-NUC-Ü and 10-M-NUM1.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Computational Mathematics (2015)

Module title			Abbreviation
Overview Numerical Mathematics 2 and Modelling for Computational Mathematics			10-M-NMC-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Aspects of mathematical modelling of technical or scientific processes. Basic principles of modelling, aspects of scaling the modelling, asymptotic series, classical methods for solving ordinary and partial differential equations, fundamental methods for numerical solution of partial differential equations and the resulting systems of linear equations; eigenvalue problems, linear programming, methods for initial value problems for ordinary differential equations, boundary value problems.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in modeling, scientific computing and numerical mathematics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to the contents of modules 10-M-NMC-Ü and 10-M-MWR.
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Computational Mathematics (2015)

Subfield Basics Specialization of Computational Mathematics

(9 ECTS credits)

Module title			Abbreviation
Stochastics 1			10-M-STO1-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Combinatorics, Laplace models, selected discrete distributions, elementary measure and integration theory, continuous distributions: normal distribution, random variable, distribution function, product measures and stochastic independence, elementary conditional probability, characteristics of distributions: expected value and variance, limit theorems: law of large numbers, central limit theorem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in stochastics, applies these methods to practical problems and knows about the typical fields of application.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Stochastics 2			10-M-STO2-152-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Elements of data analysis, statistics of data in normal and other distributions, elements of multivariate statistics.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in statistics, applies these methods to practical problems and knows about the typical fields of application.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Operations Research			10-M-ORS-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Linear programming, duality theory, transport problems, integral linear programming, graph theoretic problems.

Intended learning outcomes

The student is acquainted with the fundamental methods in operations research, as required as a central tool for solving many practical problems especially in economics. He/She is able to apply these methods to practical problems, both theoretically and numerically.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
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

270 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)

Module title			Abbreviation
Introduction to Algebra			10-M-ALG-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory.

Intended learning outcomes

The student knows and masters the essential methods and basic notions in algebra. He/She is acquainted with the central concepts in this field, 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)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Introduction to Differential Geometry			10-M-DGE-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student knows and masters the essential methods and basic notions in differential geometry. He/She is acquainted with the central concepts in this field, 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)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Ordinary Differential Equations			10-M-DGL-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Existence and uniqueness theorem; continuous dependence of solutions on initial values; systems of linear differential equations; matrix exponential series; linear differential equations of higher order.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of the theory of ordinary differential equations. He/she is able to apply these methods to practical problems.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Introduction to Complex Analysis	10-M-FTH-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)
9	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in complex analysis. He/she is able to apply these methods to practical problems.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Geometric Analysis			10-M-GAN-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in geometric analysis. He/she is able to apply these methods to practical problems.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Introduction to Discrete Mathematics			10-M-DIM-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes.

Intended learning outcomes

The student is acquainted with the fundamental concepts and results in discrete mathematics, masters the relevant proof techniques, is able to apply methods from number theory and algebra to discrete mathematics and realises the scope of applications of discrete structures.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Introduction to Functional Analysis			10-M-FAN-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)**	
9	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis.

Intended learning outcomes

The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Introduction to Partial Differential Equations	10-M-PAR-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)
9	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods in the theory of partial differential equations. He/she is able to apply these methods to practical problems.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
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

270 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Introduction to Projective Geometry	10-M-PGE-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)
9	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of projective geometry. He/she is able to apply these methods to practical problems.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
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

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Introduction to Number Theory	10-M-ZTH-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)
9	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainder, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of number theory. He/she is able to employ the basic methods and proof techniques independently.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Subfield Overview Specialization Computational Mathematics

(12 ECTS credits)

Module title			Abbreviation
Overview Algebra and Ordinary Differential Equations			10-M-ALGD-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order;.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and in the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Differential Geometry and Ordinary Differential Equations	10-M-DGGD-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces; existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in differential geometry and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Algebra and Complex Analysis			10-M-ALFT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and complex analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Complex Analysis and Differential Geometry	10-M-FTDG-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps; curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in complex analysis and differential geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Complex Analysis and Ordinary Differential Equations			10-M-FTGD-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps; existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in complex analysis and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Geometric Analysis and Differential Geometry			10-M-GADG-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology; curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in geometric analysis and differential geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Geometric Analysis and Ordinary Differential Equations			10-M-GAGD-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology; existence and uniqueness theorem; continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in geometric analysis and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Geometric Analysis and Complex Analysis			10-M-GAFT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology; complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in geometric analysis and complex analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Algebra and Projective Geometry			10-M-ALPG-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and projective geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Algebra and Discrete Mathematics	10-M-ALDI-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and discrete mathematics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Discrete Mathematics and Projective Geometry			10-M-DIPG-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes; projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in projective geometry and discrete mathematics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Functional Analysis and Differential Geometry	10-M-FADG-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in differential geometry and functional analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Functional Analysis and Ordinary Differential Equations			10-M-FAGD-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Functional Analysis and Complex Analysis			10-M-FAFT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and complex analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Functional Analysis and Geometric Analysis			10-M-FAGA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and geometric analysis. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Algebra and Number Theory			10-M-ALZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamental algebraic structures (groups, rings, fields), Galois theory; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in algebra and number theory. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Differential Geometry and Number Theory	10-M-DGZT-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in differential geometry and number theory. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Ordinary Differential Equations and Number Theory			10-M-GDZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in number theory and the theory of ordinary differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Complex Analysis and Number Theory	10-M-FTZT-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in complex analysis and number theory. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Geometric Analysis and Number Theory			10-M-GAZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Fundamentals in analysis on manifolds, submanifolds, calculus of differential forms, Stoke's theorem and applications in vector analysis and topology; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in geometric analysis and number theory. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Projective Geometry and Number Theory			10-M-PGZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Projective and affine planes, projective and affine spaces, theorem of Desargues, fundamental theorems for projective spaces, dualities and polarities of projective spaces; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in number theory and projective geometry. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Discrete Mathematics and Number Theory			10-M-DIZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Techniques from combinatorics, introduction to graph theory (including applications), cryptographic methods, error-correcting codes; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in number theory and discrete mathematics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Functional Analysis and Number Theory			10-M-FAZT-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and number theory. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Differential Geometry and Partial Differential Equations	10-M-DGPA-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Curves in Euclidean spaces, curvature, Frenet equations, local classification, submanifolds (hypersurfaces in particular) in Euclidean spaces, curvature of hypersurfaces, geodesics, isometries, main theorem on local surface theory, special classes of surfaces; examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in differential geometry and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Ordinary Differential Equations and Partial Differential Equations			10-M-GDPA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order; examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in the theory of ordinary and partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Complex Analysis and Partial Differential Equations			10-M-FTPA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Complex differentiability and Cauchy-Riemann differential equations, path integrals and Cauchy integral theorems, isolated singularities, meromorphic functions and Laurent series, residue theorem and applications, Weierstraß product theorem and theorem of Mittag-Leffler, conformal maps; examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in complex analysis and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Geometric Analysis and Partial Differential Equations			10-M-GAPA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basics in analysis on manifolds, e. g. submanifolds and calculus of differential forms, Stoke's theorem and its applications in vector calculus and topology, examples of first order partial differential equations, existence and uniqueness theorems, basic equations in mathematical physics, boundary value theorems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in geometric analysis and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Functional Analysis and Partial Differential Equations			10-M-FAPA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Partial Differential Equations and Number Theory	10-M-PAZT-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem; elementary properties of divisibility, prime numbers and prime number factorisation, modular arithmetics, prime tests and methods for factorisation, structure of the residue class rings, theory of quadratic remainders, quadratic forms, diophantine approximation and diophantine equations.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in number theory and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Overview Stochastics 1 and Stochastics 2	10-M-STO-Ü-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)
12	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Combinatorics, Laplace models, selected discrete distributions, elementary measure and integration theory, continuous distributions: normal distribution, random variable, distribution function, product measures and stochastic independence, elementary conditional probability, characteristics of distributions: expected value and variance, limit theorems: law of large numbers, central limit theorem; elements of data analysis, statistics of data in normal and other distributions, elements of multivariate statistics.

Intended learning outcomes

The student is acquainted with fundamental and advanced concepts and methods in stochastics. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in applied mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Overview Operations Research and Functional Analysis			10-M-ORFA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis; linear programming, duality theory, transport problems, integral linear programming, graph theoretic problems.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in functional analysis and operations research. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure and applied mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)

Module title			Abbreviation
Overview Operations Research and Partial Differential Equations			10-M-ORPA-Ü-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)**	
12	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Linear programming, duality theory, transport problems, integral linear programming, graph theoretic problems; examples of partial differential equations and partial differential equations of first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended learning outcomes

The student is acquainted with fundamental concepts and methods in operations research and the theory of partial differential equations. He/She is able to relate these concepts with one another, and realises the advantages of thinking across the borders of different branches in mathematics.

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

V (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)

oral examination of one candidate each (20 to 40 minutes)
Assessment will have reference to two topics in pure and applied mathematics as agreed upon with the examiner. Each topic may only be selected as the subject of one examination in the sub-fields Gesamtüberblick (Overview).
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

360 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)

Compulsory Electives Application-oriented Subject

(45 ECTS credits)

Students must successfully complete modules worth 45 ECTS credits in a single one of the focuses listed below. In addition, students must successfully complete, in the area of mandatory electives application-oriented subject, modules with numerical grading worth no less than 23 ECTS credits, cf. Section 3 Subsection 2 Sentences 2 through 4 FSB (subject-specific provisions).

Focus Biology

(45 ECTS credits)

Modules General Biology I

(ECTS credits)

Module title			Abbreviation
The Plant Kingdom			07-1A1ZPF-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		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	Admission prerequisite to assessment: exercises. Regular attendance of exercises (minimum 80%) and successful completion of the respective exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

Using the example of plants, students will be introduced to the phylogenetic diversity of eukaryotes in particular. At the level of groups in the plant kingdom, students will acquire the fundamental knowledge necessary to understand the forms and functions of plant organisms, with morphology and cytology being discussed in an evolutionary and ecological context. The contents of the module are relevant for biological disciplines at all levels of biological organisation. Students will also acquire and practise some of the fundamental preparation skills bioscientists are often required to possess.

Intended learning outcomes

- Knowledge of the specific characteristics of the intracellular and extracellular structures of plant cells and fungi.
- Ability to recognise evolution as the driving force behind the phylogeny of species.
- Familiarity with the concepts of phylogenetic relationships between plants/fungi.
- Familiarity with the distinguishing characteristics and major representatives of fungi as well as groups in the plant kingdom.
- Ability to select those plant and fungal organisms that are most suitable for particular scientific issues.
- Familiarity with the components and functioning of microscopes.
- Fundamental skills in the interpretation of macroscopic and histologic preparations by light microscopy.
- Fundamental preparation skills.

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

V (1.5) + Ü (2.5)

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

written examination (approx. 60 minutes)
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

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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Evolution and the Animal Kingdom			07-1A1TI-152-m01
Module coordinator		**Module offered by**	
holder of the Professorship of Zoology at the Department of Electronmicroscopy		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	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

The lecture *Evolution* will acquaint students with fundamental concepts and mechanisms of evolutionary biology: the origins of diversity; natural and sexual selection; speciation; population genetics. It will provide students with an introduction to phylogenetic reconstruction and will thus enable them to develop an understanding of the system of plants and animals. During the exercise, students will complete exercises on mechanistic evolution and evolutionary history. The lecture *Tierreich* (*Animal Kingdom*) will discuss the diversity of animal organisms on the basis of the phyla of the animal kingdom focusing on phylogenetic criteria. It will address the ecological constraints that led to the development of different types of body plans with their different structures and functions. In this context, the lecture will also develop an awareness in students of how important a knowledge of the fundamental principles of zoology is for research and applications not only but in particular in biology and medicine. In the exercise, students will prepare and/or examine selected species and histological preparations and will thus become familiar with the functional and morphological characteristics of the major multicellular animal phyla. In this context, students will practise working with light microscopes and stereo microscopes and will acquire fundamental preparation skills. They will prepare drawings, documenting and interpreting what they have seen.

Intended learning outcomes

Students will be familiar with the fundamental concepts and mechanisms of evolutionary biology and will know that these are key to understanding biological processes. They will have gained an overview of the diversity of animals on the basis of different types of body plans and will understand important structures in both a functional and an ecological context.

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

V (2) + Ü (3)

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 minutes)
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)

§ 41 I Nr. 1 (4 ECTS credits) and § 41 I Nr. 4 (1 ECTS credits)
§ 61 I Nr. 1 (4 ECTS credits) and § 61 I Nr. 4 (1 ECTS credits)

Module appears in
Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Modules General Biology II

(ECTS credits)

Module title			Abbreviation
Plant Physiology			07-2A2PHYPF-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

This module will acquaint students with the principles of general plant physiology and will provide them with an opportunity to develop the fundamental skills for working in a biological laboratory. The module will first address the biochemistry of the cell and will then move on to discuss the physiological processes that regulate the internal environment of plants in particular. Using the example of plants, the module will introduce students to the general principles of physiology. The module will also elaborate on the characteristic peculiarities of plants in comparison with animals and prokaryotes.

Intended learning outcomes

- Familiarity with general physiological processes in plants and the regulation of these. - Familiarity with the factors that distinguish plant physiology from animal and prokaryotic physiology. - Fundamental knowledge and skills on how to perform, analyse and present scientific experiments. - Essential lab skills. - Familiarity with methods for the investigation of fundamental physiological processes in plants.

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

V (1) + 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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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

§ 61 I Nr. 2

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)

Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Animal Physiology			07-2A2PHYTI-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

This module will acquaint students with the principles of general and comparative animal physiology and will provide them with an opportunity to develop the fundamental skills for working in a physiological laboratory. The module will focus on neurophysiology and sensory physiology as well as aspects of metabolic physiology (respiration and excretion).

Intended learning outcomes

Students have developed an understanding of the physiological functions and regulation of organisms. They have acquired fundamental knowledge on planning, setup, interpretation and presentation of scientific results.

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

V (1) + 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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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

§ 41 I Nr. 2
§ 61 I Nr. 2

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Genetics, Neurobiology, Behaviour			07-2A2GENV-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		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	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

Fundamental principles of genetics, neurobiology and behavioural biology.

Intended learning outcomes

Students will understand that there are molecular, cellular and system biological mechanisms and processes involved in animal behaviour and will be able to relate animal behaviour to the molecular and formal bases of inheritance.

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

V (3)

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)
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)

§ 61 I Nr. 2 (2 ECTS credits)
§ 61 I Nr. 3 (1 ECTS credits)
§ 61 I Nr. 4 (1 ECTS credits)

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Module studies (Bachelor) Biology (2019)
Module studies (Bachelor) Orientierungsstudien (2020)
Bachelor's degree (1 major) Biology (2021)

Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Modules General Biology III

(ECTS credits)

Module title			Abbreviation
Developmental Biology of Animals			07-3A3EBIOTI-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

In this module, students will acquire theoretical and practical background knowledge on animal developmental biology. The following topics will be covered: early embryonic development of various model organisms (amphibians, nematodes, Drosophila, mouse) and relevance for the systematics of animals, gametogenesis (production of spermatozoa and ova), differential gene expression, cell growth and molecular regulation of cell development, organogenesis, pattern formation, carcinogenesis, stem cell research and cloning, metamorphosis (amphibians, insects), eco-devo, evo-devo.

Intended learning outcomes

1. Fundamental concepts in developmental biology. 2. Embryonic and postembryonic development of selected model organisms (pattern formation). 3. Molecular mechanisms as well as control of cell development. 4. Interdisciplinary connections between developmental biology and other branches of biology. 5. Cell biology of cotyledon, cancer and stem cells as well as gametes. 6. Interrelations between ontogeny and evolution/environment. 7. Physiological aspects of the developmental processes discussed.

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

V (1) + Ü (3)

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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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

§ 61 I Nr. 5

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Biomedicine (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biomedicine (2018)

Bachelor's degree (1 major) Biomedicine (2020)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Developmental Biology of Plants			07-3A3EBIOPF-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises. Regular attendance (minimum 80%) and successful completion of exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

In this module, students will acquire an insight into the fundamental processes of plant developmental biology over a plant's entire life cycle from germination to reproduction. The module will discuss the molecular determination and regulation of different developmental biological processes in plants as well as their plasticity.

Intended learning outcomes

1. Fundamental concepts in plant developmental biology. 2. Developmental biology of selected plant model organisms. 3. Developmental biological processes at specific stages in the life cycle of plants. 4. Molecular mechanisms underlying pattern formation, morphogenesis and organogenesis in plants. 5. Establishment of plant embryonic axes. 6. Physiological aspects of the developmental processes in plants that were discussed. 7. Plasticity of developmental biological processes: regulation by endogenous and environmental factors.

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

V (1) + Ü (3)

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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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

§ 61 I Nr. 5

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Plant and Animal Ecology			07-3A3OEKO-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

This module will provide students with an overview of the interactions of plants and animals with their abiotic and biotic environments. The module will focus on the functional adaptation to environmental conditions as well as on the structure and dynamics of populations, communities and ecosystems. Students will be introduced to fundamental model concepts of ecology, will become familiar with examples of research findings and will acquire the fundamental knowledge necessary to develop an understanding of current ecological problems.

Intended learning outcomes

Students are familiar with the fundamental principles of research in the field of ecology and with the most important abiotic and biotic factors that influence the distribution and frequency of occurrence of organisms in their environment. In addition, they understand the scientific relevance ecology has to the assessment of environmental issues.

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. 90 minutes)
creditable for bonus

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)

§ 61 I Nr. 4

Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Geography (2015)
Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
First state examination for the teaching degree Gymnasium Biology (2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)

Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Geography (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Module title			Abbreviation
Genes, Molecules, Technologies			07-3A3GEMT-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The module *Gene, Moleküle, Technologien* (*Genes, Molecules, Technologies*) will include lectures on the following topics: The section *Spezielle Genetik* (*Special Genetics*) will build on *Einführung in die Genetik* (*Introduction to Genetics*) and will deepen the students' knowledge of topics from the following areas: structure and evolution of the eukaryotic genome, regulatory RNA, epigenetically and evolutionarily significant genetic mechanisms. The section will also focus on methods of gene expression profiling, reverse genetics and modern methods of gene function and gene sequence analysis. In the lecture *Einführung in die Bioinformatik* (*Introduction to Bioinformatics*), students will acquire an overview of major areas in the field of bioinformatics: protein sequence and protein domain analysis, phylogeny and evolution of sequences, protein structure, RNA/DNA sequences and structures, cellular networks (regulation, metabolism) and systems biology. During the section *Einführung in die Biotechnologie* (*Introduction to Biotechnology*), students will acquire an overview of the following topics: history of biotechnology, DNA and RNA technologies, recombinant antibodies, molecular diagnostics, nanobiotechnology, biomaterials, bioprocess engineering, microbial biotechnology, transgenic animals and plants, microfluidics. The lecture *Einführung in die Pharmakokinetik* (*Introduction to Pharmacokinetics*) will provide students with an overview of the rational development of drugs and active agents. The module component will discuss an important aspect for biologists in more detail: the optimisation of the pharmacokinetics of small molecules and proteins. Pharmacokinetics describes the uptake, distribution, metabolism and elimination of a drug or xenobiotic in an organism.

Intended learning outcomes

Students possess an advanced knowledge on genome evolution and the regulation of gene expression and are familiar with current methods in genetics as well as methods for the analysis of DNA and protein databases. They have acquired an overview of both traditional and modern methods in biotechnology and are familiar with fundamental topics in biotechnology. Students have acquired an overview of the fundamental principles of the development and review of active agents in research, clinical practice and the pharmaceutical industry. They are familiar with methods and technologies in biology and are able to evaluate potential applications of these in research and industry.

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. 90 minutes)
creditable for bonus

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
Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Module title			Abbreviation
Basic Biochemistry			07-3A3BC-152-m01
Module coordinator		**Module offered by**	
Dean of Studies Biologie (Biology)		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
4	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: exercises. Regular attendance of exercises (minimum 80%) and successful completion of the respective exercises (approx. 25 to 30 hours) are prerequisites for admission to assessment.	

Contents

With the module component *Makromoleküle* (*Macromolecules*) as a starting point, the lecture will provide students with deeper insights into the molecular biology and biochemistry of prokaryotes and eukaryotes. Students will become familiar with fundamental principles of molecular biology (replication, transcription, splicing and translation) and the biochemistry of carbohydrates, lipids, proteins and nucleic acids. Experiments will be performed on selected topics that were discussed in the lecture. The exercise will cover practical aspects of lab work (PCR, DNA and protein gel electrophoresis, blot, enzyme kinetics and detection, protein isolation).

Intended learning outcomes

Students are familiar with the fundamental principles of biochemistry.

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

V (1) + 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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

Bachelor's degree (1 major) Mathematics (2023)

Modules Mathematics/Quantitative Biology

(ECTS credits)

Module title			Abbreviation
Mathematical Biology and Biostatistics			07-M-BST-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)
4	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Fundamental principles of the most important mathematical and statistical methods in biology.

Intended learning outcomes

Students will have acquired fundamental skills in the evaluation of experiments, the interpretation of readings and numbers as well as the mathematical description of biological processes.

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 minutes)
creditable for bonus

Allocation of places

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Additional information

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Workload

120 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) Biochemistry (2015)
Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Biology (2022)

Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Modules General Biology IV

(ECTS credits)

Module title			Abbreviation
The Flora of Germany			07-4A4FLO-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Ecophysiology and Vegetation Ecology		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
7	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Modules 12-NW-EBWL and 12-NW-EVWL are not open for students of the following subjects: Wirtschaftswissenschaft (Business Management and Economics) Bachelor's (BSc with 180 ECTS credits), Wirtschaftsinformatik (Business Information Systems) Bachelor's (BSc with 180 ECTS credits) and Wirtschaftsmathematik (Mathematics for Economics) Bachelor's (BSc with 180 ECTS credits).	

Contents

The module will discuss the fundamental principles of the systematics and ecology of indigenous flowering plants. Students will acquire an overview of major indigenous plant families as well as their ecological and economic importance. Using a field guide, the course will demonstrate how dichotomous keys are used, and students will practise identifying freshly-gathered plants using dichotomous keys. Identifying plants, students will learn how to identify major morphological plant characteristics and will become familiar with the respective terminology. The module will also include field trips to typical habitats in the Botanical Garden and the vicinity of Würzburg. Students will become familiar with the common as well as scientific names of the plants found and will be introduced to the family- as well as species-specific characteristics of these plants. Students will practise using field guides and identification keys on site. Habitat ecological, geobotanical, climatic as well as conservation-relevant characteristics will also be discussed. The module will also include sessions at the Botanical Garden of the University of Würzburg with its outdoor facilities and greenhouses to help students acquire species identification skills.

Intended learning outcomes

Students have acquired knowledge and skills related to the ecology, systematics and taxonomy of indigenous flowering plants. They are familiar with the terminology of plant morphology and know how to use Floras and set up scientific herbaria.

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

V (1) + Ü (2) + E (2.5)

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

written examination (approx. 45 minutes) and practical identification assignment (approx. 45 minutes), weighted 1:1
Assessment offered: Once a year, summer semester
creditable for bonus

Allocation of places

180 places. Students applying after not having successfully completed assessment in the past two semesters will be given preferential consideration. The remaining places will be allocated by lot. A waiting list will be maintained and places re-allocated by lot as they become available. Places on all courses of the module with a restricted number of places will be allocated in the same procedure.

Additional information

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Workload

210 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) Biology (2015) Bachelor's degree (1 major) Geography (2015) Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015) Bachelor's degree (1 major) Biology (2017) Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)

Module title			Abbreviation
The Fauna of Germany			07-4A4FAU-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Animal Ecology and Tropical Biology		Faculty of Biology	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
7	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: regular attendance of field trips (minimum 80%) and completion of exercises. Regular attendance of exercises (minimum 80%) and successful completion of the respective exercises (approx. 25 to 30 hours) is a prerequisite for admission to assessment.	

Contents

In this module, students will acquire an overview of selected groups of animals to be found in Central Europe. They will acquire a fundamental knowledge of the systematics and taxonomy of these animals and will practise identifying species, using specimens of animals. Selection of specimens will be taxon-specific and will represent specific habitats or lifestyles. Exercises in a variety of habitats will provide students with an opportunity to consolidate the knowledge and skills they acquired in the lab by identifying living specimens including their ecology and behavioural biology.

Intended learning outcomes

Students possess species identification skills. They know how to taxonomically classify selected representatives of the indigenous fauna (vertebrates, invertebrates) and use identification keys. They are familiar with selected Central European habitats as well as their faunas and phenology. On the basis of the morphology and habitats of species, students are able to predict the biology and ecology of these species as well as, where applicable, to predict whether they function as indicators and are of conservation concern.

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

V (1) + Ü (2) + E (2.5)

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

written examination (approx. 45 minutes) and practical identification assignment (approx. 45 minutes), weighted 1:1
Assessment offered: Once a year, summer semester
creditable for bonus

Allocation of places

180 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.

Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

210 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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Modules Special Biosciences I

(ECTS credits)

Module title			Abbreviation
Neurobiology 1			07-4S1NVO1-152-m01

Module coordinator	Module offered by
holder of the Chair of Neurobiology and Genetics	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

Neurobiology and methods in molecular neurobiology (neurogenetic model system Drosophila and humans) -- focus: sleep behaviour and endogenous clock.

Intended learning outcomes

Students have acquired an advanced knowledge of the neurobiology of a model organism and are able to apply the relevant methods in neurobiology.

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

Ü (4) + S (1)

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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
creditable for bonus

Allocation of places

20 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according

to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Integrative Behavioral Biology 1	07-4S1NVO2-152-m01

Module coordinator	Module offered by
holder of the Chair of Behavioral Physiology and Sociobiology	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

Communication in the animal kingdom, neuroethology and behavioural development, perception and processing of olfactory signals, temporal organisation of behaviour, adaptive feeding behaviour, reproductive behaviour, social behaviour, orientation mechanisms.

Intended learning outcomes

Students have acquired an advanced knowledge in the area of behavioural biology and are able to deliver presentations on current studies on relevant topics.

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

V (2) + S (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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
creditable for bonus

Allocation of places

20 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics))

at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Functional Morphology of Arthropods			07-4S1NV03-152-m01

Module coordinator	Module offered by
holder of the Chair of Animal Ecology and Tropical Biology	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

Morphology, anatomy, phylogeny and ecology of arthropods.

Intended learning outcomes

Students are able to explain arthropod radiations in a functional context as well as to explain the importance of arthropods to ecosystems.

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

V (1) + Ü (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)

term paper (approx. 5 to 10 pages)
creditable for bonus

Allocation of places

20 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 %

of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major) Biology (2022)

Module title			Abbreviation
Biology and Ecology of Arthropods			07-4S1NV05-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Animal Ecology and Tropical Biology		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

More in-depth discussion of the structure and dynamics of human and animal populations; regulation of population density; management.

Intended learning outcomes

Students are able to interpret the structure and dynamics of populations and metapopulations on the basis of model concepts in population ecology and to apply more advanced methods of quantitative analysis to these.

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

Ü (4) + S (1)

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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
creditable for bonus

Allocation of places

15 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according

to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Basics in Light- and Electron-Microscopy			07-4S1MZ1-152-m01
Module coordinator		**Module offered by**	
head of the Department of Electronmicroscopy		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 confocal laser scanning microscopy and electron microscopy.

Intended learning outcomes

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

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

V (1) + Ü (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)

written examination (approx. 30 to 60 minutes)
creditable for bonus

Allocation of places

18 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.

Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)

Module title			Abbreviation
Analysis of Chromosomes			07-4S1MZ2-152-m01
Module coordinator		**Module offered by**	
head of the Department of Electronmicroscopy		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

Overview of the structure of chromosomes of somatic and meiotic cells.

Intended learning outcomes

Students are able to analyse chromosomal structures.

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

V (1) + Ü (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)

written examination (approx. 30 to 60 minutes)
creditable for bonus

Allocation of places

18 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.

Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.
Additional information
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Workload
150 h
Teaching cycle
--
Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor's degree (1 major) Biology (2015) Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015) Bachelor's degree (1 major) Biology (2017) Bachelor's degree (1 major) Biology (2021) Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020) Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021) Bachelor's degree (1 major) Biology (2022)

Module title			Abbreviation
Methods in Biotechnology			07-4S1AMB-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Biotechnology and Biophysics		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

This module (lecture and seminar) will provide students with an overview of instrument-based methods in biotechnology and biomedicine and the underlying physical principles. It will discuss modern methods for the analysis of biological matter on the molecular and cellular level. These methods include light microscopy, fluorescence spectroscopy, electron microscopy, atomic force microscopy, flow cytometry and microfluidics.

Intended learning outcomes

Students will gain an overview of key methods in biotechnology and their respective advantages and disadvantages. They will learn to decide what method is most suitable for addressing a particular issue.

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

V (2) + S (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. 30 to 60 minutes)
creditable for bonus

Allocation of places

25 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.

Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

150 h

Teaching cycle

--

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

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Module appears in

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Aspects of Molecular Biotechnology			07-4S1MOLB-152-m01

Module coordinator	Module offered by
holder of the Chair of Biotechnology and Biophysics	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 "white" biotechnology, bioreactors, biocatalysis, immobilisation of cells and enzymes, production of biomolecules, molecular biology, recombinant DNA technology, protein engineering, biosensor design, drug design, drug targeting, molecular diagnostics, recombinant antibodies, hybridoma technology, electromanipulation of cells.

Intended learning outcomes

Students will gain an overview of traditional and modern methods in biotechnology and their respective advantages and disadvantages. They will learn to decide what method is most suitable for addressing a particular issue. Students will acquire a knowledge of fundamental methods in biotechnology that will enable them to independently review relevant literature. In addition, they will become acquainted with - or, where necessary, will be able to independently acquaint themselves with - relevant mechanisms.

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

V (2) + S (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. 30 to 60 minutes)
creditable for bonus

Allocation of places

25 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking.

Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Master's degree (1 major) Functional Materials (2016)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Biology (2022)
Master's degree (1 major) Functional Materials (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)
Master's degree (1 major) Functional Materials (2025)

Module title			Abbreviation
Special Bioinformatics 1			07-4S1MZ6-152-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	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

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

Intended learning outcomes

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

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

V (1) + Ü (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)

Log (approx. 10 to 20 pages)
Language of assessment: German or English
creditable for bonus

Allocation of places

20 places. Should the number of applications exceed the number of available places, places will be allocated as follows:
Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.

Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Molecular modelling - From DNA to Protein			07-4S1PS1-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Plant Physiology and Biophysics		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

This module will equip students with advanced knowledge on the structure and function of nucleic acids and proteins as well as on the search for and analysis and modelling of plant macromolecules using databases and specific software.

Intended learning outcomes

Students have acquired a specialist knowledge of the structure-function relationships of macromolecules and are able to work with relevant databases and software.

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

V (1) + Ü (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)

computerised practical examination (approx. 6 hours)
creditable for bonus

Allocation of places

18 places. Should the number of applications exceed the number of available places, places will be allocated as follows:
Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology;

among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

Module title			Abbreviation
Methods in Plant Ecophysiology			07-4S1PS2-152-m01

Module coordinator	Module offered by
holder of the Chair of Plant Physiology and Biophysics	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

Complex experiments to introduce students to the current state of research in plant ecophysiology as well as discussion of experimental findings in a comprehensive scientific context.

Intended learning outcomes

Students are able to use current methods in plant ecophysiology as well as to document experimental findings and put these in a scientific context.

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

Ü (4) + S (1)

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

Log (approx. 10 to 20 pages)
creditable for bonus

Allocation of places

15 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 %

of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)

Module title			Abbreviation
Pharmaceutical Drugs in Plants			07-4S1PS3-152-m01
Module coordinator		**Module offered by**	
holder of the Chair of Pharmaceutical Biology		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

This module will introduce students to the major active agent groups in medicinal plants and phytopharmaceuticals as well as to their application in pharmacy. Microscopic and phytochemical analyses will be performed and the requirements and analytical methods of the pharmacopoeia will be explained.

Intended learning outcomes

Students have acquired a specialist knowledge on active agents from medicinal plants and phytopharmaceuticals as well as on the requirements and analytical methods of the pharmacopoeia.

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

Ü (4) + S (1)

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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
creditable for bonus

Allocation of places

15 places.
Should the number of applications exceed the number of available places, places will be allocated as follows: Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematik (Mathematics), each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their

average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50 % of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25 % of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25 % of places): lottery.
Should the module be used only in the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Workload

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) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Laboratory Practical Course I			07-S1-LP1-152-m01
Module coordinator		**Module offered by**	
Coordinator BioCareers		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	Please consult with course advisory service in advance.	

Contents

This practical coursed is offered by an institution that is part of the University. Contents to be determined by the respective institution.

Intended learning outcomes

Students have developed skills which qualify them to work in their profession.

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

P (5)
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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Excursion I			07-S1-Ex1-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	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	Please consult with course advisory service in advance.

Contents

Contents of the field trip to be determined by the respective institution.

Intended learning outcomes

Students have developed skills which qualify them to work in their profession.

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

E (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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Interdisciplinary Project I			07-S1-IP1-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	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	Please consult with course advisory service in advance.

Contents

Contents of the project to be determined by the competent coordinators; contents will vary according to topic.

Intended learning outcomes

Students have developed skills which qualify them to work in their profession.

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

R (5)
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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)

Bachelor's degree (1 major) Biology (2022) Bachelor's degree (1 major) Mathematics (2023)

Modules Special Biosciences II

(ECTS credits)

Module title	Abbreviation
External Practical Course	07-5EP-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	Faculty of Biology

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	Please consult with course advisory service in advance.

Contents

Students will complete a placement at an authority, a non-university research institution or a business. Contents to be determined by the respective institution.

Intended learning outcomes

Students are familiar with the structures of external institutions and businesses and have developed skills which qualify them to work in their profession.

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

P (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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
Language of assessment: German and/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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major) Biology (2022)
exchange program Biosciences (2022)

Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Excursion II			07-S2-EX2-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	Faculty of Biology

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	Please consult with course advisory service in advance.

Contents

Contents of the field trip to be determined by the respective institution.

Intended learning outcomes

Students have developed skills which qualify them to work in their profession.

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

E (8)
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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
Language of assessment: German and/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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Interdisciplinary Project II			07-S2-IP2-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	Faculty of Biology

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	Please consult with course advisory service in advance.

Contents

Contents of the project to be determined by the competent coordinators; contents will vary according to topic.

Intended learning outcomes

Students have developed skills which qualify them to work in their profession.

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

R (8)
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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
Language of assessment: German and/or English
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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)

exchange program Biosciences (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Laboratory Practical Course II			07-S2-LP2-152-m01

Module coordinator	Module offered by
Coordinator BioCareers	Faculty of Biology

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	Please consult with course advisory service in advance.

Contents

This practical coursed is offered by an institution that is part of the University. Contents to be determined by the respective institution.

Intended learning outcomes

Students are familiar with the structures of internal institutions and have developed skills which qualify them to work in their profession.

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

P (8)
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. 45 to 60 minutes) or
b) log (approx. 10 to 20 pages) or
c) oral examination of one candidate each (approx. 30 minutes) or
d) oral examination in groups of up to 3 candidates (approx. 20 minutes per candidate) or
e) presentation (approx. 20 to 30 minutes) or
f) practical examination (on average approx. 2 hours; time to complete will vary according to subject area but will not exceed a maximum of 4 hours).
Students will be informed about the method and length of the assessment prior to the course.
Language of assessment: German and/or English
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

Bachelor's degree (1 major) Biology (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2015)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major) Biology (2021)
Bachelor's degree (1 major, 1 minor) Biology (Minor, 2020)

Bachelor's degree (1 major, 1 minor) Biology (Minor, 2021)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Mathematics (2023)

Focus Chemistry

(45 ECTS credits)

Compulsory Courses

(21 ECTS credits)

Module title			Abbreviation
Experimental Chemistry			08-AC-ExChem-152-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Experimentalchemie" (Experimental Chemistry)		Institute of Inorganic Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The module provides an overview of the fundamental knowledge of chemistry. Emphasis is placed on the material and particle level, metals, acid-base reactions, the periodic table, chemical equilibrium and complexometry.

Intended learning outcomes

The student understands the principles of the periodic table and can obtain information from it. He/she is proficient in basic models of the structure of matter and can describe them properly. He/she can depict chemical reactions using typical chemical formula language and interpret them by identifying the type of reaction.

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. 90 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

Teaching cycle: every year, winter semester

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

--

Module appears in

Bachelor's degree (1 major) Biology (2011)
Bachelor's degree (1 major) Psychology (2010)
Bachelor's degree (1 major, 1 minor) Pedagogy (2013)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2013)
Bachelor's degree (1 major, 1 minor) Russian Language and Culture (2008)
Bachelor's degree (2 majors) Special Education (2009)
Magister Theologiae Catholic Theology (2013)
Bachelor's degree (2 majors) English and American Studies (2009)
Bachelor's degree (2 majors) German Language and Literature (2013)
Bachelor's degree (1 major) Geography (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Musicology (2015)
Bachelor's degree (1 major) Physics (2015)

Bachelor's degree (1 major) Psychology (2015)
Bachelor's degree (1 major) Business Management and Economics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Music Education (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Political and Social Studies (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Academic Speech Therapy (2015)
Bachelor's degree (1 major) Indology/South Asian Studies (2015)
Bachelor's degree (1 major, 1 minor) Egyptology (2015)
Bachelor's degree (1 major, 1 minor) Pedagogy (2015)
Bachelor's degree (1 major, 1 minor) History (2015)
Bachelor's degree (1 major, 1 minor) Musicology (2015)
Bachelor's degree (1 major, 1 minor) Philosophy (2015)
Bachelor's degree (1 major, 1 minor) Pre- and Protohistoric Archaeology (2015)
Bachelor's degree (1 major, 1 minor) Ancient World (2015)
Bachelor's degree (1 major, 1 minor) Philosophy and Religion (2015)
Bachelor's degree (1 major, 1 minor) Theological Studies (2015)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2015)
Bachelor's degree (1 major, 1 minor) Russian Language and Culture (2015)
Bachelor's degree (1 major, 1 minor) German Language and Literature (2015)
Bachelor's degree (2 majors) Egyptology (2015)
Bachelor's degree (2 majors) Pedagogy (2015)
Bachelor's degree (2 majors) Protestant Theology (2015)
Bachelor's degree (2 majors) Musicology (2015)
Bachelor's degree (2 majors) Philosophy (2015)
Bachelor's degree (2 majors) Special Education (2015)
Bachelor's degree (2 majors) Pre- and Protohistoric Archaeology (2015)
Bachelor's degree (2 majors) Latin Philology (2015)
Bachelor's degree (2 majors) Music Education (2015)
Bachelor's degree (2 majors) Philosophy and Religion (2015)
Bachelor's degree (2 majors) Theological Studies (2015)
Bachelor's degree (2 majors) Political and Social Studies (2015)
Bachelor's degree (2 majors) Russian Language and Culture (2015)
Bachelor's degree (2 majors) Greek Philology (2015)
Bachelor's degree (2 majors) European Ethnology (2015)
Bachelor's degree (2 majors) Indology/South Asian Studies (2015)
Bachelor's degree (2 majors) Geography (2015)
Bachelor's degree (2 majors) French Studies (2015)
Bachelor's degree (2 majors) History (2015)
Bachelor's degree (2 majors) Sport Science (Focus on health and Pedagogics in Movement) (2015)
Bachelor's degree (2 majors) German Language and Literature (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major, 1 minor) French Studies (2016)
Bachelor's degree (2 majors) French Studies (2016)
Bachelor's degree (1 major, 1 minor) Italian Studies (2016)
Bachelor's degree (2 majors) Italian Studies (2016)
Bachelor's degree (1 major, 1 minor) Spanish Studies (2016)
Bachelor's degree (2 majors) Spanish Studies (2016)
Bachelor's degree (1 major) Romanic Languages (French/Italian) (2016)
Bachelor's degree (1 major) Romanic Languages (French/Spanish) (2016)
Bachelor's degree (1 major) Romanic Languages (Italian/Spanish) (2016)
Bachelor's degree (1 major) Business Information Systems (2016)

Bachelor's degree (1 major) Games Engineering (2016)
Bachelor's degree (1 major, 1 minor) English and American Studies (2016)
Bachelor's degree (2 majors) English and American Studies (2016)
Bachelor's degree (1 major) Media Communication (2016)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2016)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major, 1 minor) Geography (2017)
Bachelor's degree (1 major, 1 minor) History of Medieval and Modern Art (2017)
Bachelor's degree (2 majors) History of Medieval and Modern Art (2017)
Bachelor's degree (2 majors) Comparative Indo-European Linguistics (2017)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2017)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Games Engineering (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Media Communication (2018)
Bachelor's degree (1 major) Biomedicine (2018)
Bachelor's degree (1 major) Human-Computer Systems (2018)
Bachelor's degree (2 majors) Classical Archaeology (2018)
Bachelor's degree (1 major, 1 minor) Classical Archaeology (2018)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2018)
Bachelor's degree (2 majors) Digital Humanities (2018)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major, 1 minor) English and American Studies (2019)
Bachelor's degree (1 major) Indology/South Asian Studies (2019)
Bachelor's degree (1 major) Business Information Systems (2019)
Bachelor's degree (2 majors) Indology/South Asian Studies (2019)
Bachelor's degree (1 major) Business Management and Economics (2019)
Bachelor's degree (1 major) Modern China (2019)
Bachelor's degree (1 major) Biomedicine (2020)
Bachelor's degree (1 major) Pedagogy (2020)
Bachelor's degree (1 major) Political and Social Studies (2020)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2020)
Bachelor's degree (2 majors) European Ethnology (2020)
Bachelor's degree (2 majors) Political and Social Studies (2020)
Bachelor's degree (2 majors) Special Education (2020)
Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2020)
Bachelor's degree (1 major, 1 minor) Pedagogy (2020)
Bachelor's degree (2 majors) Pedagogy (2020)
Bachelor's degree (1 major) Psychology (2020)
Bachelor's degree (1 major) Biology (2021)
Magister Theologiae Catholic Theology (2021)
Bachelor's degree (2 majors) History (2021)
Bachelor's degree (1 major, 1 minor) History (2021)
Bachelor's degree (1 major) Media Communication (2021)
Bachelor's degree (2 majors) Theological Studies (2021)
Bachelor's degree (1 major, 1 minor) Theological Studies (2021)
Bachelor's degree (1 major, 1 minor) English and American Studies (2021)

Bachelor's degree (2 majors) English and American Studies (2021)
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (2 majors) Comparative Indo-European Linguistics (2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (2 majors) Special Education (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Business Management and Economics (2021)
Bachelor's degree (1 major) Human-Computer Systems (2022)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2022)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (2 majors) Ancient Near Eastern Archaeology (2022)
Bachelor's degree (1 major, 1 minor) Ancient World (2022)
Bachelor's degree (2 majors) Ancient Near Eastern Studies (2022)
Bachelor's degree (1 major) Franco-German studies: language, culture, digital competence (2022)
Bachelor's degree (1 major) European Law (2023)
Bachelor's degree (1 major, 1 minor) English and American Studies (2023)
Bachelor's degree (2 majors) English and American Studies (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major, 1 minor) History of Medieval and Modern Art (2023)
Bachelor's degree (2 majors) History of Medieval and Modern Art (2023)
Bachelor's degree (2 majors) Special Education (2023)
Bachelor's degree (1 major) Business Management and Economics (2023)
Bachelor's degree (1 major) Geography (2023)
Bachelor's degree (2 majors) Geography (2023)
Bachelor's degree (1 major, 1 minor) Geography (2023)
Bachelor's degree (2 majors) European Ethnology/Empiric Cultural Studies (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (2 majors) German Language and Literature (2024)
Bachelor's degree (1 major, 1 minor) German Language and Literature (2024)
Bachelor's degree (1 major) Music Education (2024)
Bachelor's degree (2 majors) Music Education (2024)
Bachelor's degree (1 major, 1 minor) Music Education (2024)
Bachelor's degree (1 major) Indology/South Asian Studies (2024)
Bachelor's degree (2 majors) Indology/South Asian Studies (2024)
Bachelor's degree (1 major, 1 minor) Indology/South Asian Studies (2024)
Bachelor's degree (1 major, 1 minor) Ancient World (2024)
Bachelor's degree (2 majors) Digital Humanities (2024)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2024)
Bachelor's degree (1 major) Midwifery (2024)
Bachelor's degree (2 majors) Greek Philology (2024)
Bachelor's degree (2 majors) Latin Philology (2024)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Business Management and Economics (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Bachelor's degree (1 major) Human-Computer-Interaction (2024)
Bachelor's degree (2 majors) Art Education (2024)
Bachelor's degree (1 major) Digital Business & Data Science (2024)
Bachelor's degree (1 major) Classics (2024)
Bachelor's degree (1 major) Diversity, Ethics and Religions (2024)
Bachelor's degree (1 major) Functional Materials (2025)
Bachelor's degree (1 major) (2025)
Bachelor's degree (1 major, 1 minor) European Ethnology/Empiric Cultural Studies (2025)
Bachelor's degree (1 major) Pedagogy (2025)
Bachelor's degree (2 majors) Pedagogy (2025)
Bachelor's degree (1 major) Economathematics (2025)
Bachelor's degree (1 major) Academic Speech Therapy (2025)
Bachelor's degree (1 major, 1 minor) Pedagogy (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Organic Chemistry 1			08-OC1-152-m01
Module coordinator		**Module offered by**	
holder of the Professorship of Organic Chemistry		Institute of Organic Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

This module provides students with an overview of the fundamental principles of organic chemistry. It examines the bonding situation of carbon and introduces students to the nomenclature of simple and moderately complex organic compounds. The module also discusses the fundamental principles of stereochemistry, substitution, addition and elimination reactions as well as synthesis planning.

Intended learning outcomes

Students know important categories of substances in organic chemistry. They are able to use different systems of nomenclature to determine simple substance names. Students are able to analyse the stereochemistry of molecules. They are able to describe and formulate some of the most important reactions in organic chemistry. For that purpose, they can analyse and categorise the characteristic reaction conditions and can use them for simple syntheses.

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

V (3) + Ü (1)

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

according to § 2 para. 2 sentence 2 APOLmCh in conjunction with No. I 2nd letter b) of annex 1 to the APOLmCh and No. 2 of annex 2 to the APOLmCh

Workload

150 h

Teaching cycle

Teaching cycle: every year, summer semester

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

§ 62 I Nr. 2

Module appears in

Bachelor's degree (1 major) Biology (2011)
Bachelor's degree (1 major) Chemistry (2010)
Bachelor's degree (1 major) Psychology (2010)
Bachelor's degree (1 major, 1 minor) Pedagogy (2013)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2013)
Bachelor's degree (1 major, 1 minor) Russian Language and Culture (2008)

Bachelor's degree (2 majors) Special Education (2009)
Magister Theologiae Catholic Theology (2013)
Bachelor's degree (2 majors) English and American Studies (2009)
Bachelor's degree (2 majors) German Language and Literature (2013)
Bachelor's degree (1 major) Biochemistry (2015)
Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Geography (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Musicology (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Psychology (2015)
Bachelor's degree (1 major) Business Management and Economics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Music Education (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Political and Social Studies (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Academic Speech Therapy (2015)
Bachelor's degree (1 major) Indology/South Asian Studies (2015)
Bachelor's degree (1 major, 1 minor) Egyptology (2015)
Bachelor's degree (1 major, 1 minor) Pedagogy (2015)
Bachelor's degree (1 major, 1 minor) History (2015)
Bachelor's degree (1 major, 1 minor) Musicology (2015)
Bachelor's degree (1 major, 1 minor) Philosophy (2015)
Bachelor's degree (1 major, 1 minor) Pre- and Protohistoric Archaeology (2015)
Bachelor's degree (1 major, 1 minor) Ancient World (2015)
Bachelor's degree (1 major, 1 minor) Philosophy and Religion (2015)
Bachelor's degree (1 major, 1 minor) Theological Studies (2015)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2015)
Bachelor's degree (1 major, 1 minor) Russian Language and Culture (2015)
Bachelor's degree (1 major, 1 minor) German Language and Literature (2015)
Bachelor's degree (2 majors) Egyptology (2015)
Bachelor's degree (2 majors) Pedagogy (2015)
Bachelor's degree (2 majors) Protestant Theology (2015)
Bachelor's degree (2 majors) Musicology (2015)
Bachelor's degree (2 majors) Philosophy (2015)
Bachelor's degree (2 majors) Special Education (2015)
Bachelor's degree (2 majors) Pre- and Protohistoric Archaeology (2015)
Bachelor's degree (2 majors) Latin Philology (2015)
Bachelor's degree (2 majors) Music Education (2015)
Bachelor's degree (2 majors) Philosophy and Religion (2015)
Bachelor's degree (2 majors) Theological Studies (2015)
Bachelor's degree (2 majors) Political and Social Studies (2015)
Bachelor's degree (2 majors) Russian Language and Culture (2015)
Bachelor's degree (2 majors) Greek Philology (2015)
Bachelor's degree (2 majors) European Ethnology (2015)
Bachelor's degree (2 majors) Indology/South Asian Studies (2015)
First state examination for the teaching degree Gymnasium Chemistry (2015)
Bachelor's degree (2 majors) Geography (2015)
Bachelor's degree (2 majors) French Studies (2015)
Bachelor's degree (2 majors) History (2015)
Bachelor's degree (2 majors) Sport Science (Focus on health and Pedagogics in Movement) (2015)
Bachelor's degree (2 majors) German Language and Literature (2015)

Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major, 1 minor) French Studies (2016)
Bachelor's degree (2 majors) French Studies (2016)
Bachelor's degree (1 major, 1 minor) Italian Studies (2016)
Bachelor's degree (2 majors) Italian Studies (2016)
Bachelor's degree (1 major, 1 minor) Spanish Studies (2016)
Bachelor's degree (2 majors) Spanish Studies (2016)
Bachelor's degree (1 major) Romanic Languages (French/Italian) (2016)
Bachelor's degree (1 major) Romanic Languages (French/Spanish) (2016)
Bachelor's degree (1 major) Romanic Languages (Italian/Spanish) (2016)
Bachelor's degree (1 major) Business Information Systems (2016)
Bachelor's degree (1 major) Games Engineering (2016)
Bachelor's degree (1 major, 1 minor) English and American Studies (2016)
Bachelor's degree (2 majors) English and American Studies (2016)
Bachelor's degree (1 major) Media Communication (2016)
Bachelor's degree (1 major) Food Chemistry (2016)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2016)
Bachelor's degree (1 major) Biology (2017)
Bachelor's degree (1 major, 1 minor) Geography (2017)
Bachelor's degree (1 major, 1 minor) History of Medieval and Modern Art (2017)
Bachelor's degree (2 majors) History of Medieval and Modern Art (2017)
Bachelor's degree (2 majors) Comparative Indo-European Linguistics (2017)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2017)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Games Engineering (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Media Communication (2018)
Bachelor's degree (1 major) Biomedicine (2018)
Bachelor's degree (1 major) Human-Computer Systems (2018)
Bachelor's degree (2 majors) Classical Archaeology (2018)
Bachelor's degree (1 major, 1 minor) Classical Archaeology (2018)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2018)
Bachelor's degree (2 majors) Digital Humanities (2018)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major, 1 minor) English and American Studies (2019)
Bachelor's degree (1 major) Indology/South Asian Studies (2019)
Bachelor's degree (1 major) Business Information Systems (2019)
Bachelor's degree (2 majors) Indology/South Asian Studies (2019)
Bachelor's degree (1 major) Business Management and Economics (2019)
Bachelor's degree (1 major) Modern China (2019)
Module studies (Bachelor) Orientierungsstudien (2020)
Bachelor's degree (1 major) Biomedicine (2020)
Bachelor's degree (1 major) Pedagogy (2020)
Bachelor's degree (1 major) Political and Social Studies (2020)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major, 1 minor) Political and Social Studies (2020)
Bachelor's degree (2 majors) European Ethnology (2020)
Bachelor's degree (2 majors) Political and Social Studies (2020)
Bachelor's degree (2 majors) Special Education (2020)
Bachelor's degree (1 major) Physics (2020)

Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2020)
Bachelor's degree (1 major, 1 minor) Pedagogy (2020)
Bachelor's degree (2 majors) Pedagogy (2020)
Bachelor's degree (1 major) Psychology (2020)
Bachelor's degree (1 major) Biology (2021)
Magister Theologiae Catholic Theology (2021)
Bachelor's degree (2 majors) History (2021)
Bachelor's degree (1 major, 1 minor) History (2021)
Bachelor's degree (1 major) Media Communication (2021)
Bachelor's degree (2 majors) Theological Studies (2021)
Bachelor's degree (1 major, 1 minor) Theological Studies (2021)
Bachelor's degree (1 major, 1 minor) English and American Studies (2021)
Bachelor's degree (2 majors) English and American Studies (2021)
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (2 majors) Comparative Indo-European Linguistics (2021)
Bachelor's degree (1 major) Food Chemistry (2021)
Bachelor's degree (1 major) Quantum Technology (2021)
Bachelor's degree (2 majors) Special Education (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Business Management and Economics (2021)
Bachelor's degree (1 major) Human-Computer Systems (2022)
Bachelor's degree (1 major, 1 minor) Museology and material culture (2022)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Biology (2022)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (2 majors) Ancient Near Eastern Archaeology (2022)
Bachelor's degree (1 major, 1 minor) Ancient World (2022)
Bachelor's degree (2 majors) Ancient Near Eastern Studies (2022)
Bachelor's degree (1 major) Franco-German studies: language, culture, digital competence (2022)
Bachelor's degree (1 major) European Law (2023)
Bachelor's degree (1 major, 1 minor) English and American Studies (2023)
Bachelor's degree (2 majors) English and American Studies (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major, 1 minor) History of Medieval and Modern Art (2023)
Bachelor's degree (2 majors) History of Medieval and Modern Art (2023)
Bachelor's degree (2 majors) Special Education (2023)
Bachelor's degree (1 major) Business Management and Economics (2023)
Bachelor's degree (1 major) Geography (2023)
Bachelor's degree (2 majors) Geography (2023)
Bachelor's degree (1 major, 1 minor) Geography (2023)
Bachelor's degree (2 majors) European Ethnology/Empiric Cultural Studies (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (2 majors) German Language and Literature (2024)

Bachelor's degree (1 major, 1 minor) German Language and Literature (2024)
Bachelor's degree (1 major) Music Education (2024)
Bachelor's degree (2 majors) Music Education (2024)
Bachelor's degree (1 major, 1 minor) Music Education (2024)
Bachelor's degree (1 major) Indology/South Asian Studies (2024)
Bachelor's degree (2 majors) Indology/South Asian Studies (2024)
Bachelor's degree (1 major, 1 minor) Indology/South Asian Studies (2024)
Bachelor's degree (1 major, 1 minor) Ancient World (2024)
Bachelor's degree (2 majors) Digital Humanities (2024)
Bachelor's degree (1 major, 1 minor) Digital Humanities (2024)
Bachelor's degree (1 major) Midwifery (2024)
Bachelor's degree (2 majors) Greek Philology (2024)
Bachelor's degree (2 majors) Latin Philology (2024)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Business Management and Economics (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Bachelor's degree (1 major) Human-Computer-Interaction (2024)
Bachelor's degree (2 majors) Art Education (2024)
Bachelor's degree (1 major) Digital Business & Data Science (2024)
Bachelor's degree (1 major) Classics (2024)
Bachelor's degree (1 major) Diversity, Ethics and Religions (2024)
Bachelor's degree (1 major) Functional Materials (2025)
Bachelor's degree (1 major) (2025)
Bachelor's degree (1 major) Food Chemistry (2025)
Bachelor's degree (1 major, 1 minor) European Ethnology/Empiric Cultural Studies (2025)
Bachelor's degree (1 major) Pedagogy (2025)
Bachelor's degree (2 majors) Pedagogy (2025)
Bachelor's degree (1 major) Economathematics (2025)
Bachelor's degree (1 major) Academic Speech Therapy (2025)
Bachelor's degree (1 major, 1 minor) Pedagogy (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title	Abbreviation
Principles of quantum mechanics and spectroscopy for engineering students	08-PC-QMS-FU-152-m01

Module coordinator	Module offered by
lecturer of lecture "Grundlagen der Quantenmechanik and Spektroskopie" (Principles of Quantum Mechanics and Spectroscopy)	Institute of Physical and Theoretical Chemistry

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

This module introduces students to the fundamental principles of quantum mechanics. It analyses molecules on the basis of the following models: particle in a box, harmonic oscillator and rigid rotor. As regards spectroscopy, the module focuses on vibrational spectroscopy, angular momentum quantisation, microwave spectroscopy and UV-VIS spectroscopy. In addition, the module discusses linear operators, eigenvalue problems, matrix representation, differential equations, Fourier transform and orthogonal functions as mathematical bases of the topics listed above.

Intended learning outcomes

Students are able to explain key models of quantum mechanics and to apply them to molecules. They are able to describe different spectroscopic methods. In addition, students know how to apply the mathematical bases of quantum mechanics.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) 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
creditable for bonus

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

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Functional Materials (2021)

Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Functional Materials (2025)

Module title	Abbreviation
Quantum Chemistry	08-TC-152-m01

Module coordinator	Module offered by
lecturer of lecture "Quantenchemie"	Institute of Physical and Theoretical Chemistry

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

This module provides students with deeper insights into advanced topics in quantum chemistry. It focuses on spin, the Pauli principle, Slater determinants, the Hartree-Fock method, correlation energy, configuration interaction and excited states, the Born-Oppenheimer approximation and bonding models of H2+.

Intended learning outcomes

Students are able to describe excited states of molecules with the help of key concepts and models.

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

V (2) + Ü (1)

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
creditable for bonus

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Grundschule Chemistry (2015)
First state examination for the teaching degree Realschule Chemistry (2015)
First state examination for the teaching degree Gymnasium Chemistry (2015)
First state examination for the teaching degree Mittelschule Chemistry (2015)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)
First state examination for the teaching degree Mittelschule Chemistry (2020 (Prüfungsordnungsversion 2015))
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Mathematics (2023)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Functional Materials (2025)

Compulsory Electives

(24 ECTS credits)

Module title	Abbreviation
Organic Chemistry 2 and analytical methods in organic chemistry	08-OC2-152-m01

Module coordinator	Module offered by
holder of the Chair of Physically Organic Chemistry	Institute of Organic Chemistry

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

This module introduces students to the rules of aromaticity and discusses specific reactions of aromatics. Using the example of carbonyl compounds, it extends the students' knowledge of substitution, elimination and addition reactions to complex reaction mechanisms. The course also focuses on oxidation and reduction reactions as well as rearrangement. In addition, it introduces students to the spectroscopic methods of infrared spectroscopy, mass spectrometry and NMR spectroscopy.

Intended learning outcomes

Students have become familiar with the criteria for aromaticity. They can analyse the varying reactivity of carbonyl compounds. They are able to describe specific reactions of carbonyls and aromatics. For that purpose, they can plan and formulate multi-stage syntheses with complex reaction mechanisms and can transfer them to unknown reactions. Students are able to describe important spectroscopic methods, to evaluate a spectrum and to draw conclusions regarding the molecular structure.

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

V (3) + Ü (1) + V (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

270 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) Biochemistry (2015)
Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)

Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Functional Materials (2025)

Module title			Abbreviation
Thermodynamics, Kinetics, Electrochemistry			08-PC-TKE-152-m01

Module coordinator	Module offered by
lecturer of lecture "Thermodynamik, Kinetik, Elektrochemie"	Institute of Physical and Theoretical Chemistry

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

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

This module introduces students to the principles of thermodynamics. It focuses on the laws of thermodynamics, chemical equilibria, ideal and real gasses/solutions/mixed phases and electrochemistry. In addition to thermodynamic processes, it discusses the fundamental principles of kinetics.

Intended learning outcomes

Students are able to explain the laws of thermodynamics. They are able to describe thermodynamic aspects of solutions, gases, mixed phases and electrochemical reactions. Students are able to interpret the kinetic aspects of chemical reactions.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) 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
creditable for bonus

Allocation of places

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Additional information

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Workload

270 h

Teaching cycle

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

§ 62 I Nr. 1

Module appears in

Bachelor's degree (1 major) Biochemistry (2015)
Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Gymnasium Chemistry (2015)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)

Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Functional Materials (2025)

Module title			Abbreviation
Symmetry, chemical bonding and light			08-PC-SBL-152-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Symmetrie, chemische Bindung and Licht"		Institute of Physical and Theoretical Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
9	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
2 semester	undergraduate	--	

Contents

This module provides an introduction to the symmetry of molecules. It focuses on group theory, symmetry operations, point groups, character tables and selection rules. The module deals with the chemical bond based on the qualitative MO theory and gives an introduction to the fundamentals of computational chemistry. It also gives students the opportunity to analyse the interactions between symmetry, chemical bonding and light in detail.

Intended learning outcomes

Students are able to analyse the symmetry of molecules. They are able to draw conclusions about the spectroscopic properties of a particular molecule from the symmetry of that molecule.

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

V (3) + Ü (2) + V (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes) 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

270 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) Biochemistry (2015)
Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Inorganic Chemistry of the Elements			08-AS1-152-m01
Module coordinator		**Module offered by**	
lecturer of lecture "Chemie der Hauptgruppenelemente" (Chemistry of Main-group Elements)		Institute of Inorganic Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

This module equips students with an advanced knowledge of the periodic table and selected elements. It focuses on bonding conditions, trends in the periodic table and the description and structure of elements. In addition, it introduces students to elementary organic chemistry, coordination chemistry and complex chemistry.

Intended learning outcomes

Students are able to characterise main group elements and transition metal elements in terms of their structure, reactivity and fabrication. They are able to identify the coordination of the atoms. In addition, they have learned how to use the periodic table, an essential tool for chemists.

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

V (2) + V (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

according to § 2 para. 2 sentence 2 APOLmCh in conjunction with No. I 2nd letter a) of annex 1 to the APOLmCh and No. 1 of annex 2 to the APOLmCh

Workload

180 h

Teaching cycle

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

§ 62 I Nr. 1

Module appears in

Bachelor's degree (1 major) Biochemistry (2015)
Bachelor's degree (1 major) Chemistry (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Chemistry (2015)
Bachelor's degree (1 major) Biochemistry (2017)
Bachelor's degree (1 major) Chemistry (2017)
Module studies (Bachelor) Chemistry (2019)

Module studies (Bachelor) Orientierungsstudien (2020)
Bachelor's degree (1 major) Food Chemistry (2021)
Bachelor's degree (1 major) Biochemistry (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Food Chemistry (2025)

Focus Computer Science

(45 ECTS credits)

Module title			Abbreviation
Introduction to Programming			10-I-EinP-152-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	undergraduate	--	

Contents

Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.

Intended learning outcomes

The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.

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).
creditable for bonus

Allocation of places

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Additional information

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Workload

150 h

Teaching cycle

Teaching cycle: only in winter semester

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

§ 49 I Nr. 1 b)
§ 69 I Nr. 1 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Business Information Systems (2015)
Bachelor's degree (1 major) Human-Computer Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Business Information Systems (2016)
Bachelor's degree (1 major) Business Information Systems (2019)

Module title	Abbreviation
Algorithms and data structures	10-I-ADS-152-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)
10	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Design and analysis of algorithms, recursion vs. iteration, sort and search methods, data structures, abstract data types, lists, trees, graphs, basic graph algorithms, programming in Java.

Intended learning outcomes

Students are proficient in independently designing, precisely describing and analyzing algorithms. The students know the basic paradigms for the design of algorithms and can implement them in practical programs. Students are able to estimate the runtime behavior of algorithms and prove the correctness of algorithms.

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).
creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

Teaching cycle: only in winter semester

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

§ 49 I Nr. 1 a)
§ 69 I Nr. 1 a)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Human-Computer Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Software Technology			10-I-ST-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Object-oriented software development with UML, development of graphical user interfaces, foundations of databases and object-relational mapping, foundations of web programming (HTML, XML), software development processes, unified process, agile software development, project management, quality assurance.

Intended learning outcomes

The students possess a fundamental theoretical and practical knowledge on the design and development of software 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).
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).
creditable for bonus

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

Teaching cycle: only in summer semester

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

§ 49 I Nr. 1 b)
§ 69 I Nr. 1 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Human-Computer Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Business Information Systems (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)

Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Business Information Systems (2019)
Module studies (Bachelor) Orientierungsstudien (2020)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Digital Business & Data Science (2024)

Module title			Abbreviation
Practical Course in Programming			10-I-PP-152-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)**	
10	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1-2 semester	undergraduate	--	

Contents

The programming language Java. Independent creation of small to middle-sized, high-quality Java programs.

Intended learning outcomes

The students are able to independently develop small to middle-sized, high-quality Java programs.

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

P (6)

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).

Allocation of places

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Additional information

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Workload

300 h

Teaching cycle

Teaching cycle: every semester

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

§ 49 I Nr. 1 c)
§ 69 I Nr. 1 d)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Human-Computer Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's degree (1 major) Functional Materials (2016)
Bachelor's degree (1 major) Computer Science (2017)
Master's degree (1 major) Functional Materials (2022)
Master's degree (1 major) Functional Materials (2025)

Module title			Abbreviation
Practical course in software			10-I-SWP-152-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)**	
10	(not) successfully completed	10-I-PP, 10-I-ST	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	In addition, the knowledge and skills acquired in module 10-I-ADS are required. Prior attendance of this module is therefore highly recommended.	

Contents

Completion of a project assignment in groups, problem analysis, creation of requirements specifications, specification of solution components (e. g. UML) and milestones, user manual, programming documentation, presentation and delivery of the runnable software product in a colloquium.

Intended learning outcomes

The students possess the practical skills for the design, development and execution of a software project in small teams.

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

P (6)

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

practical project (Completion of a larger software project in groups (approx. 300 hours per person) and final presentation (approx. 10 minutes per group)

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)

§ 69 I Nr. 1 d)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Digital computer systems			10-I-RAL-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Introduction to digital technologies, Boolean algebras, combinatory circuits, synchronous and asynchronous circuits, hardware description languages, structure of a simple processor, machine programming, memory hierarchy.

Intended learning outcomes

The students possess a knowledge of the fundamentals of digital technologies up to the design and programming of easy microprocessors as well as knowledge for the application of hardware description languages for the design of digital 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).
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).
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

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Module studies (Bachelor) Orientierungsstudien (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)

Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Master'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
Information Transmission			10-I-IÜ-152-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)**	
10	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Introduction to probability calculus, coding theory, coding for fault detection and fault correction, information theory, spectrum and Fourier transform, modulation technique, structure of digital transmission systems, introduction to the structure of computer networks, communication protocols.

Intended learning outcomes

The students possess a technical, theoretical and practical knowledge of the structure of systems for information transmission, a knowledge that is necessary to understand these 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).
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).
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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Module title			Abbreviation
Practical course in hardware			10-I-HWP-152-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)**	
10	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Practical experiments on hardware aspects, for example in communication technology, robots or the structure of a complete microprocessor.

Intended learning outcomes

The students are able to independently review, prepare and perform experiments with the help of experiment descriptions, to independently search for additional information as well as to document and evaluate experiment results.

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

P (6)

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

portfolio: completion of approx. 3 to 10 project assignments (approx. 250 hours total) and presentation of results (approx. 10 minutes per project)

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Module studies (Bachelor) Computer Science (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) Aerospace Computer Science (2020)

Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Mathematics (2023)
Master'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 Informatics			10-I-TIV-152-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	undergraduate	--	

Contents

Computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of calculations, P-NP problem, NP completeness.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of computations, P-NP problem, NP completeness.

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).

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)

§ 49 I Nr. 1 a)
§ 69 I Nr. 1 a)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (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) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)

Module title	Abbreviation
Tutorial Theoretical Informatics	10-I-TIT-152-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	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of calculations, P-NP problem, NP completeness.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of computations, P-NP problem, NP completeness.

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)

a) completion of approx. 11 exercises with approx. 4 components each (50% to be completed correctly) or
b) written examination (approx. 180 to 240 minutes)
Method of assessment to be selected by the candidate.

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)

§ 49 I Nr. 1 a)
§ 69 I Nr. 1 a)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)

Module title	Abbreviation
Logic for informatics	10-I-LOG-152-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	undergraduate	--

Contents

Syntax and semantics of propositional logic, equivalence and normal forms, Horn formulas, SAT, resolution, infinite formula sets, syntax and semantics of predicate logic.

Intended learning outcomes

The students are proficient in the following areas: syntax and semantics of propositional logic, equivalence and normal forms, Horn formulas, SAT, resolution, infinite formula sets, syntax and semantics of predicate logic.

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (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) Aerospace Computer Science (2020)

Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Mathematics (2023)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Algorithmic Graph Theory			10-I-AGT-152-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	undergraduate	--	

Contents

We discuss typical graph problems: We solve round trip problems, calculate maximal flows, find matchings and colourings, work with planar graphs and find out how the ranking algorithm of Google works. Using the examples of graph problems, we also become familiar with new concepts, for example how we model problems as linear programs or how we show that they are fixed parameter computable.

Intended learning outcomes

The students are able to model typical problems in computer science as graph problems. In addition, the participants are able to decide which tool from the course helps solve a given graph problem algorithmically. In this course, students learn in detail how to estimate the run time of given 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

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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

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Bachelor's degree (1 major) Computer Science (2019)
Module studies (Bachelor) Computer Science (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) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title	Abbreviation
Interactive Computer Graphics	10-I=ICG-152-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

Computer graphics studies methods for digitally synthesising and manipulating visual content. This course specifically concentrates on interactive graphics with an additional focus on 3D graphics as a requirement for many contemporary as well as for novel human-computer interfaces and computer games. The course will cover topics about light and images, lighting models, data representations, mathematical formulations of movements, projection as well as texturing methods. Theoretical aspects of the steps involved in ray-tracing and the raster pipeline will be complemented by algorithmical approaches for interactive image syntheses using computer systems. Accompanying software solutions will utilise modern graphics packages and languages like OpenGL, GLSL and/or DirectX.

Intended learning outcomes

At the end of the course, the students will have a broad understanding of the underlying theoretical models of computer graphics. They will be able to implement a prominent variety of these models, to build their own interactive graphics applications and to choose the right software tool for this 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):
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

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Master's degree (1 major) Computer Science (2016)

Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)

Module title			Abbreviation
Databases			10-I-DB-152-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	undergraduate	--	

Contents

Relational algebra and complex SQL statements; database planning and normal forms; transaction management.

Intended learning outcomes

The students possess knowledge about database modelling and queries in SQL as well as transactions.

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)

§ 49 I Nr. 1 b)
§ 69 I Nr. 1 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Business Information Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Realschule Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's degree (1 major) Physics (2016)
Bachelor's degree (1 major) Business Information Systems (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)

Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Business Information Systems (2019)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Mathematical Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Bachelor's degree (1 major) Functional Materials (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Knowledge-based Systems			10-I-WBS-152-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	undergraduate	--	

Contents

Foundations in the following areas: knowledge management systems, knowledge representation, solving methods, knowledge acquisition, learning, guidance dialogue, semantic web.

Intended learning outcomes

The students possess theoretical and practical knowledge for the understanding and design of knowledge-based systems including knowledge formalisation and have acquired experience in a small project.

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Business Information Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Business Information Systems (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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Business 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)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Bachelor's degree (1 major) Business Information Systems (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Data Mining			10-I-DM-152-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	undergraduate	--	

Contents

Foundations in the following areas: definition of data mining and knowledge, discovery in databases, process model, relationship to data warehouse and OLAP, data preprocessing, data visualisation, unsupervised learning methods (cluster and association methods), supervised learning (e. g. Bayes classification, KNN, decision trees, SVM), learning methods for special data types, other learning paradigms.

Intended learning outcomes

The students possess a theoretical and practical knowledge of typical methods and algorithms in the area of data mining and machine learning. They are able to solve practical knowledge discovery problems with the help of the knowledge acquired in this course and by using the KDD process. They have acquired experience in the use or implementation of data 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
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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Business Information Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Bachelor's degree (1 major) Business Information Systems (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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Business 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)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Master's degree (1 major) Information Systems (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Business Information Systems (2023)
Master'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
Object oriented Programming			10-I-OOP-152-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	undergraduate	--	

Contents

Polymorphism, generic programming, meta programming, web programming, templates, document management.

Intended learning outcomes

The students are proficient in the different paradigms of object-oriented programming and have experience in their practical use.

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Business Information Systems (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's degree (1 major) Physics (2016)
Master's degree (1 major) Nanostructure Technology (2016)
Bachelor's degree (1 major) Business Information Systems (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)

Bachelor's degree (1 major) Business Information Systems (2019)

Module title	Abbreviation
Computational Complexity	10-I-KT-152-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	undergraduate	--

Contents

Complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Computer Science (2017)

Module title			Abbreviation
Cryptography and Data Security			10-I-KD-152-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	undergraduate	--	

Contents

Private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography systems, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response methods, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption.

Intended learning outcomes

The students possess a fundamental and applicable knowledge in the areas of private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response method, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Computer Science (2017)

Module title	Abbreviation
3D Point Cloud Processing	10-I-3D-152-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)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Laser scanning, Kinect and camera models, basic data structures (lists, arrays, oc-trees), calculating normals, k-d trees, registration, features, segmentation, tracking, applications for airborne mapping, applications to mobile mapping.

Intended learning outcomes

Students understand the fundamental principles of all aspects of 3D point cloud processing and are able to communicate with engineers / surveyors / CV people / etc. Students are able to solve problems of modern sensor data processing and have experienced that real application scenarios are challenging in terms of computational requirements, in terms of memory requirements and in terms of implementation issues.

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)

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Bachelor's degree (1 major) Computer Science (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) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Operating Systems			10-I-BS-152-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	undergraduate	--	

Contents

Introduction to computer systems, development of operating systems, architecture principles, interrupt processing in operating systems, processes and threads, CPU scheduling, synchronisation and communication, memory management, device and file management, operating system virtualisation.

Intended learning outcomes

The students possess knowledge and practical skills in building and using essential parts of operating systems.

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

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Master's degree (1 major) Physics (2016)
Master's degree (1 major) Nanostructure Technology (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Module title			Abbreviation
Computer Architecture			10-I-RAK-152-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	undergraduate	--	

Contents

Instruction set architectures, command processing through pipelining, statical and dynamic instruction scheduling, caches, vector processors, multi-core processors.

Intended learning outcomes

The students master the most important techniques to design fast computers as well as their interaction with compilers and operating systems.

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)

§ 22 II Nr. 3 b)
§ 69 I Nr. 1 c): Rechnerarchitektur

Module appears in

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
Master's degree (1 major) Physics (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (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) Physics International (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's degree (1 major) Mathematics (2023)
Master's degree (1 major) Physics International (2024)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025)
Bachelor's degree (1 major) Games Engineering (2025)

Module title			Abbreviation
Computer Networks and Communication Systems			10-I-RK-152-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	undergraduate	--	

Contents

Properties of computer and communication systems: data traffic in distributed systems. Performance analysis of computer networks and communication systems: problem statement and introduction to method architecture and structure of computer networks: network structure, network access, access methods, digital transfer hierarchies, dataflow control and traffic control, transfer network. Communication protocols: fundamental principles and ISO architecture models. Internet: structure and basic mechanism, TCP/IP, routing, network management. Mobile communication networks: fundamental concepts, GSM, UMTS. Future communication systems and networks.

Intended learning outcomes

The students possess an intricate knowledge of the structure of computer networks and communication systems as well as fundamental principles to rate these 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).
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

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

Bachelor's degree (1 major) Computer Science (2015)
Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
First state examination for the teaching degree Gymnasium Computer Science (2015)
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)

Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)

Module title			Abbreviation
Automation and Control Technology			10-I-AR-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	undergraduate	--	

Contents

Overview of automation systems, foundations of control technology, simple design methods, model creation, differential equations, nomenclature, transfer function, step response and realising of easy linear controllers, structure images and structure image reduction, locus curves and Bode diagrams, frequency characteristic, persistent control deviation, controller design through parameter optimisation, basics of fuzzy control, scanning systems, eigenvalue based system analysis, classification of automation and control systems, examples.

Intended learning outcomes

The students master the fundamentals of automation and control.

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

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Workload

240 h

Teaching cycle

--

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

§ 22 II Nr. 3 b)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Games Engineering (2025)

Focus Physics

(45 ECTS credits)

Compulsory Courses

(14 ECTS credits)

Module title			Abbreviation
Classical Physics 1 for Students of Physics related Disciplines			11-ENNF1-152-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)**	
7	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.	

Contents

1. Principles: Physical quantities, prefactors, derived quantities, dimensional analysis, time / length / mass (definition, measurement procedures, SI), importance of metrology;
2. Point Mechanics: Kinematics, motion in 2D and 3D / vectors, special cases: Uniform and constant accelerated motion, free fall, slate litter; circular motion in polar coordinates;
3. Newton's laws: Forces and momentum definition, weight vs. mass forces on the pendulum, forces on an atomic scale, isotropic and anisotropic friction. Preparation of the equations of motion and solutions;
4. Work and energy: (Kinetic) performance, examples;
5. Elastic, inelastic and super-elastic collision: Energy and momentum conservation, surges in centre of mass and balance system, rocket equation;
6. Conservative and non-conservative force fields: Potential, potential energy; law, weight scale, field strength and potential of gravity (general relations);
7. Rotational motion: Angular momentum, angular velocity, torque, rotational energy, moment of inertia, analogies to linear translation, applications, satellites (geostationary and interstellar), escape velocities, trajectories in the central potential;
8. Tidal forces: Inertial system, reference systems, apparent forces, Foucault pendulum, Coriolis force, centrifugal force;
9. Galilean transformation: Brief digression to Maxwell's equations, ether, Michelson interferometer, Einstein's postulates, problem of simultaneity, Lorentz transformation, time dilation and length contraction, relativistic impulse;
10. Rigid body and gyroscope: Determining the centre of mass, inertia tensor and -ellipsoid, principal axes and their stability, tensor on the example of the elasticity tensor, physics of the bike; gyroscope: Precession and nutation, the Earth as a spinning top;
11. Friction: Static and dynamic friction, stick-slip motion, rolling friction, viscous friction, laminar flow, eddy formation;
12. Vibration: Representation by means of complex e-function, equation of motion (DGL) on forces, torque and power approach, Taylor expansion, harmonic approximation; spring and pendulum, physical pendulum, damped vibration (resonant case, Kriechfall, aperiodic limit), forced vibration, Fourier analysis;
13. Coupled vibrations: Eigenvalues and eigenfunctions, double pendulum, deterministic vs. chaotic motion, non-linear dynamics and chaos;
14. Waves: Wave equation, transverse and longitudinal waves, polarisation, principle of superposition, reflection at the open and closed end, speed of sound; interference, Doppler effect; phase and group velocity, dispersion relation;
15. Elastic deformation of solid bodies: Elastic modulus, general Hooke's law, elastic waves;
16. Fluids: Hydrostatic pressure and buoyancy, surface tension and contact angle, capillary forces, steady flows, Bernoulli equation; Boyle-Mariotte, gas laws, barometric height formula, air pressure, compressibility and compressive modulus;
17 . Kinetic theory of gases: ideal and real gas, averages, distribution functions, equipartition theorem, Brownian motion, collision cross section, mean free path, diffusion and osmosis, degrees of freedom, specific heat

Intended learning outcomes

The students understand the basic contexts and principles of mechanics, vibration, waves and kinetic theory of gases. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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

Workload

210 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Mathematics (2023)

Module title			Abbreviation
Classical Physics 2 for Students of Physics related Disciplines			11-ENNF2-152-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)**	
7	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.	

Contents

1. Thermodynamics (linked to 11-E-M); temperature and quantity of heat, thermometer, Kelvin scale;
2. Heat conduction, heat transfer, diffusion, convection, radiant heat;
3. Fundamental theorems of thermodynamics, entropy, irreversibility, Maxwell's demon;
4. Heat engines, working diagrams, efficiency, example: Stirling engine;
5. Real gases and liquids, states of matter (also solids), van der Waals, critical point, phase transitions, critical phenomena (opalescence), coexistence region, Joule-Thomson;
6. Electrostatics, basic concepts: Electrical charge, forces; electric field, reps. field concept, field lines, field of a point charge;
7. Gaussian sentence, related to Coulomb's law, definition of "river"; Gaussian surface, divergence theorem; special symmetries; divergence and GS in differential form;
8. Electrical potential, working in the E-box, electric. potential, potential difference, voltage; potential equation, equipotential surfaces; several important examples: Sphere, hollow sphere, capacitor plates, electric dipole; lace effects, Segner wheel;
9. Matter in the E-field, charge in a homogeneous field, Millikan experiment, Braun tube; electron: Field emission, thermionic emission, dipole in homogeneous and inhomogeneous field; induction, Faraday cage;
10. Capacitor, mirror charge, definition, capacity; plate and spherical capacitor; combination of capacitors; media in the capacitor; electrical polarisation, displacement and orientation polarisation, microscopic image; dielectric displacement; electrolytic capacitor; Piezoelectric effect;
11. Electricity, introduction, current density, drift velocity, conduction mechanisms;
12. Resistance and conductivity, resistivity, temperature dependence; Ohm's law; realisations (resistive and non-ohmic, NTC, PTC);
13. Circuits, electrical networks, Kirchhoff's rules (meshes, nodes); internal resistance of a voltage source, measuring instruments; Wheatstone bridge;
14. Power and energy in the circuit; Capacitor charge; galvanic element; thermovoltage;
15. Transfer mechanisms, conduction in solids: Band model, semiconductor; line in liquids and gases;
16. Magnetostatics, fundamental laws; permanent magnet, field properties, definitions and units; Earth's magnetic field; Amper's Law, analogous to e-box, magn. river, swirl;
17. Vector potential, formal derivation, analogous to electric scalar potential; calculation of fields, examples, Helmholtz coils;
18. Moving charge in the static magnetic field, current balance, Lorentz force, right-hand rule, electric motor; dipole field; movement paths, mass spectrometer, Wien filters, Hall effect; electron: e / m determination;
19. matter in the magnetic field, effects of the field on matter, relative permeability, susceptibility; para-, dia-, ferromagnetism; magn. moment of the electron, behaviour at interfaces;
20. induction, Faraday's law of induction, Lenz's rule, flux change, eddy electric field, Waltenhofen's pendulum; inductance,self-induction; applications: Transformer, generator;
21. Maxwell's displacement current, choice of integration area, displacement current; Maxwell's extension, wave equation; Maxwell equations;
22. AC: Fundamentals, sinusoidal vibrations, amplitude, period and phase; power and RMS value, ohmic resistance; Capacitive & inductive resistor, capacitor and coil, phase shift and frequency dependence; impedance: Complex resistance; performance of the AC;

23. Resonant circuits, combinations of RLC; series and parallel resonant circuit; forced vibration, damped harmonic oscillator (related to 11-E-M);
24: Hertz dipole, characteristics of irradiation, near field, far field; Rayleigh scattering; accelerated charge, synchrotron radiation, X-rays; 25. Electromagnetic waves: Principles, Maxwell's determination to electromagnetism, radiation pressure (Poynting vector, radiation pressure).

Intended learning outcomes

The students understand the basic principles and contexts of thermodynamics, science of electricity and magnetism. They know relevant experiments to observe and measure these principles and contexts. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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

Workload

210 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Mathematics (2023)

Compulsory Electives 1

(3 ECTS credits)

Students must take either module 11-PNNF or the two modules 11-P-PA and 11-P-FR1. Other combinations are not permitted.

Module title	Abbreviation
Laboratory Course Physics for Students of Physics Related Disciplines	11-PNNF-152-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)
3	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Simple experiments in the fields of mechanics, vibration theory, thermodynamics, optics, X-rays, nuclear magnetic resonance, Atomic and Nuclear Physics, imaging methods.

Intended learning outcomes

The students have detected and understood physical contexts on the basis of the implementation of own experiments. They have a basic understanding of physical phenomena and know the basic ideas and ways of functioning of different measuring and imaging methods as well as their applications, especially in the field of Biomedicine.

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)

a) practical assignment with oral test (approx. 15 minutes, during experiments) and b) written examination (90 minutes).
Each experiment comprises preparation, performance and evaluation. Test as well as performance of experiments can each be repeated once.

Allocation of places

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Additional information

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Workload

90 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
Bachelor's degree (1 major) Functional Materials (2021)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Functional Materials (2025)

Module title			Abbreviation
Laboratory Course Physics A (Mechanics, Heat, Electromagnetism)			11-P-PA-152-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)
3	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Measurement tasks in mechanics, thermodynamics and electricity theory, e.g. measurement of voltages and currents, heat capacity, calorimetry, density of bodies, dynamic viscosity, elasticity, surface tension, spring constant, drafting of graphics and drafting of measurement protocols.

Intended learning outcomes

The students know and have mastered physical measuring methods and experimenting techniques. They are able to independently plan and conduct experiments, to cooperate with others, and to document the results in a measuring protocol.

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

P (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)

practical assignment with talk (approx. 30 minutes)
Preparing, performing and evaluating (record of readings or lab report) the experiments will be considered successfully completed if a Testat (exam) is passed. Exactly one experiment that was not successfully completed can be repeated once. After completion of all experiments, talk (with discussion; approx. 30 minutes) to test the candidate's understanding of the physics-related contents of the module. Talks that were not successfully completed can be repeated once. Both components of the assessment have to be successfully completed.

Allocation of places

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Additional information

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Workload

90 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) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Physics (2020)

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

Module title	Abbreviation
Data and Error Analysis	11-P-FR1-152-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)
2	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.

Contents

Types of errors, error approximation and propagation, graphic representations, linear regression, mean values and standard deviation.

Intended learning outcomes

The students are able to evaluate measuring results on the basis of error propagation and of the principles of statistics and to draw, present and discuss the conclusions.

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

V (1) + Ü (1)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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

Workload

60 h

Teaching cycle

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

§ 53 I Nr. 1 c)
§ 77 I Nr. 1 d)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)

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

Module title			Abbreviation
Laboratory Course Physics B for Students of other Disciplines			11-P-NFB-152-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)**	
4	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Students are highly recommended to complete modules 11-P-PA and 11-P-FR1 prior to completing module 11-P-NFB.	

Contents

Physical laws of optics, vibrations and waves, science of electricity and circuits with electric components.

Intended learning outcomes

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

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

P (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)

practical assignment with talk (approx. 30 minutes)
Preparing, performing and evaluating (record of readings or lab report) the experiments will be considered successfully completed if a Testat (exam) is passed. Exactly one experiment that was not successfully completed can be repeated once. After completion of all experiments, talk (with discussion; approx. 30 minutes) to test the candidate's understanding of the physics-related contents of the module. Talks that were not successfully completed can be repeated once. Both components of the assessment have to be successfully completed.

Allocation of places

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Additional information

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Workload

120 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) Mathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematics (2023)

Compulsory Electives 2

(22 ECTS credits)

Module title			Abbreviation
Optics and Waves			11-E-O-152-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	undergraduate	--	

Contents

1. Light (linked to 11-E-E): basic concepts, the speed of light, Huygens-Fresnel principle: reflection, refraction.
2. Light in matter: propagation velocity in the medium; dispersion, complex and frequency-dependent dielectric constant; absorption, Kramers-Kronig relation, interfaces, Fresnel equations, polarization, generation by absorption, birefringence, optical activity (dipole)
3. Geometrical optics: basic concepts, Fermat's principle, optical path, planar interfaces, Snell's law, total reflection, optical tunneling, evanescent waves, prism; normal and anomalous dispersion, curved interfaces, thin and thick lenses, lens systems, lens grinder formula, aberrations, imaging errors (spherical & chromatic aberration, astigmatism, coma, distortion, correction approaches).
4. Optical instruments: characteristics; camera, eye, magnifying glass, microscope, telescope types, bundle beam vs. image construction (electron lenses, electron microscope), confocal microscopy.
5. Wave optics: spatial and temporal coherence, Young's double slit experiment, interference pattern (intensity profile), thin films, parallel layers, wedge-shaped layers, phase shift, Newton rings, interferometer (Michelson, Mach-Zender, Fabry-Perot).
6. Diffraction in the far field: Fraunhofer diffraction, , single slit, intensity distribution, apertures, resolving power, Rayleigh & Abbé criterion, Fourier optics, optical grating, n-fold slit, intensity distribution, grating spectrometer and resolution, diffraction off atomic lattices, convolution theorem.
7. Diffraction in the near field: Fresnel, near-field diffraction at circular apertures/disks, Fresnel zone plate, near-field microscopy, holography, Huygens-Fresnel concept; white light hologram.
8. Failure of classical physics I - from light wave to photon: black body radiation and Planck's quantum hypothesis; photoelectric effect and Einstein's explanation, Compton effect, light as a particle, wave-particle duality, , quantum structure of nature
9. Failure of classical physics II - particles as waves: de Broglie's matter wave concept; diffraction of particle waves (Davisson-Germer-experiment, double slit interference).
10. Wave mechanics: wave packets, phase and group velocity (recap of 11-EM), uncertainty principle, Nyquist-Shannon theorem, wave function as probability amplitude, probability of residence, measurement process in quantum mechanics (double-slit experiment & which-way information, collapse of the wave function, Schrödinger's cat).
11. Mathematical concepts of quantum mechanics: Schrödinger equation as wave equation, conceptual comparison to wave optics, free particle and particles in a potential, time-independent Schrödinger equation as eigenvalue equation, simple examples in 1D (potential step, potential barrier and tunnel effect, box potential and energy quantization, harmonic oscillator), box potential in higher dimensions and degeneracy, formal theory of QM (states, operators, observables).

Intended learning outcomes

The students understand the basic principles and contexts of radiation, wave and quantum optics. They understand the theoretical concepts and know the structure and application of important optical instruments and measuring methods. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
written examination (approx. 120 minutes) Language of assessment: German and/or English
Allocation of places
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Additional information
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Workload
240 h
Teaching cycle
--
Referred to in LPO I (examination regulations for teaching-degree programmes)
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Module appears in
Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2015) Bachelor's degree (1 major) Mathematical Physics (2016) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major, 1 minor) Physics (Minor, 2020) Bachelor's degree (1 major) Mathematics (2023) exchange program Physics (2023) Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Atoms and Quanta			11-E-A-152-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	undergraduate	--	

Contents

1. Structure of atoms: Experimental evidence for the existence of atoms, size of the atom, charges and masses in the atom, isotopes, internal structure, Rutherford experiment, instability of the "classical" Rutherford atom.
2. Quantum mechanical foundations of Atomic Physics (short recap of part A.): Light as particle beam, particles as waves, wave functions and probability of presence, uncertainty relation and stability of atoms, energy quantisation in atoms, Franck-Hertz experiment, atomic spectra, Bohr's model and its limitations, non-relativistic Schrödinger equation.
3. The non-relativistic hydrogen atom: Hydrogen and hydrogen-like atoms, central potential and angular momentum in QM, Schrödinger equation of the H-atom, atomic orbitals: Radial and angular wave functions, quantum numbers, energy eigenvalues.
4. Atoms in external fields: orbital magnetic dipole moment, gyromagnetic ratio, magentic fields: normal Zeeman effect, electrical fields: Stark effect.
5. Fine and hyperfine structure: Electron spin and magnetic spin moment, Stern-Gerlach experiment, Einstein-de Haas effect, glimpse of the Dirac equation (spin as a relativistic phenomenon and existence of antimatter), electron spin resonance (ESR), spin-orbit interaction, relativistic fine structure, Lamb shift (quantum electrodynamics), nuclear spin and hyperfine structure.
6. Multi-electron atoms: Helium atom as simplest example, indistinguishability of identical particles, (anti)symmetry with respect to particle exchange, fermions and bosons, relation to spin, Pauli principle, orbital and spin wave function of two-particle systems (spin singlets and triplets), LS- and jj-coupling, Periodic Table of the Elements, Aufbau principles and Hund's rules.
7. Light-matter interaction: Time-dependent perturbation theory (Fermi's Golden Rule) and optical transitions, matrix elements and dipole approximation, selection rules and symmetry, line broadening (lifespan, Doppler effect, collision broadening), atomic spectroscopy.
8. Laser: Elementary optical processes (absorption, spontaneous and stimulated emission), stimulated emission as light amplification, Einstein's rate equations, thermal equilibrium, non-equilibrium character of a laser: Rate equations, population inversion and laser condition, basic structure of a laser, optical pumping, 2-, 3- and 4-level lasers, examples (ruby laser, He-Ne laser, semiconductor laser).
9. Inner-shell excitations and X-ray physics: Generation of x-radiation, bremsstrahlung and characteristic spectrum, X-ray emission for elemental analysis (EDX), X-ray absorption and contrast formation in X-ray images, X-ray photoemission, non-radiative Auger processes, synchrotron radiation, application examples.
10. Molecules and chemical bonding: Molecular hydrogen ion (H_2^+) as simplest example: Rigid molecule approximation and LCAO approach, bonding and anti-bonding molecular orbitals, hydrogen molecule (H_2): Molecular orbital vs. Heitler-London approximation, diatomic heteronuclear molecules: covalent vs. ionic bonding, van der Waals bonds and Lennard-Jones potential, (time allowing: conjugated molecules).
11. Molecule rotations and vibrations: Born-Oppenheimer approximation, energy levels of the rigid rotator (symmetric and asymmetrical molecules), centrifugal expansion, molecule as (an)harmonic oscillator, Morse potential, normal modes, vibrational-rotational interaction.
12. Molecular spectroscopy: Transition matrix elements, vibrational spectroscopy: Infrared spectroscopy and Raman effect, vibrational-rotational transitions: Fortrat diagram, electronic transitions: Franck-Condon principle.

Intended learning outcomes

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

formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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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

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

Module title	Abbreviation
Introduction to Solid State Physics	11-E-F-152-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	undergraduate	--

Contents

1. The free-electron gas (FEG), free electrons; density of states; Pauli principle; Fermi-Dirac statistics; spec. heat, Sommerfeld coefficient; electrons in fields: Drude-Lorentz-Sommerfeld; electrical and thermal conductivity, Wiedemann-Franz law; Hall effect; limitations of the model
2. Crystal structure, periodic lattice; types of lattices; Bravais lattice; Miller indices; simple crystal structures; lattice defects; polycrystals; amorphous solids; group theoretical approaches, the importance of symmetry for electronic properties
3. The reciprocal lattice (RG), motivation: Diffraction; Bragg condition; definition; Brillouin zones; diffraction theory: Scattering; Ewald construction; Bragg equation; Laue's equation; structure and form factor
4. Structure determination, probes: X-ray, electron, neutron; methods: Laue, Debye-Scherrer, rotating crystal; electron diffraction, LEED
5. lattice vibrations (phonons), equations of motion; dispersion; group velocity; diatomic base: optical, acoustic branch; quantisation: Phonon momentum; optical properties in the infrared; dielectric function (Lorentz model); examples of dispersion curves (occ. Kramers-Kronig), measurement methods
6. Thermal properties of insulators, Einstein and Debye model; phonon density of states; anharmonicity and thermal expansion; thermal conductivity; Umklapp processes; crystal defects
7. Electrons in a periodic potential, Bloch theorem; band structure; approximation of nearly free electrons (NFE); strongly bound electrons (tight binding, LCAO); examples of band structures, Fermi surfaces, spin-orbit interaction
8. Superconductivity, BCS theory, pairing, coupling of bosonic and fermionic modes, band structure, many-particle aspects (quasiparticle concept)

Intended learning outcomes

The students understand the basic contexts and principles of Solid-State Physics (bonding and structure, lattice dynamics, thermal properties, principles of electronic properties (free electron gas)). They understand the structure of solids and know the experimental methods and theoretical models for the description of phenomena of Solid-State Physics. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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

Module title	Abbreviation
Nuclear and Elementary Particle Physics	11-E-T-152-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	undergraduate	--

Contents

1. Overview, historical introduction, history and significance of Nuclear and Particle Physics
2. Methods of Nuclear Physics, scattering and spectroscopy, nuclear radius, composition of matter, mass and charge distribution in the nucleus, the discovery of the proton and neutron
3. Nuclear models, the mass of the atomic nuclei, droplet model, bonding energy, nuclear shell model
4. Structure of cores, angular momentum, spin, parity, mag. and electr. moments, collective excitation forms, spin-orbit interaction
5. Radioactivity and spectroscopy, radioactive decay, natural and civilisational sources of ionising radiation
6. Nuclear energy, nuclear fission, nuclear reactors, nuclear fusion, star power, star development, formation of the chemical elements of hydrogen
7. Radiation and matter, interaction of radiation and matter, Bethe-Bloch formula, photoelectric effect, pair production
8. Instruments, accelerators and detectors
9. Electromagnetic interaction, differential cross section, virtual photons, Feynman graphs, exchange interaction
10. Strong interaction, quarks, gluons, colour and degree of freedom, deep-inelastic electron-proton scattering, confinement, asymptotic freedom, particle zoo, isospin, strangeness, SU (3) symmetry, antiprotons
11. Weak interaction, cracked mirror symmetries, Wu experiment, charge conjugation, time reversal, CP invariance, exchange particles, W and Z, neutrinos, neutrino vibrations
12. Standard model, three families of leptons and quarks, quark-lepton symmetry, Higgs boson, free parameters

Intended learning outcomes

The students understand the basic connections between fundamental Nuclear and Elementary Particle Physics. They have an overview of the experimental observations of Particle Physics and the theoretical models which describe them.

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

V (3) + Ü (1)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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

Module title			Abbreviation
Theoretical Mechanics			11-T-M-152-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	Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.	

Contents

1. Newton's formulation: Inertial systems, Newton's laws of motion, equations of motion; one-dimensional motion, energy conservation; Harmonic oscillator; Movement in space of intuition, conservative forces;
2. Lagrangian formulation: Variational principles, Euler-Lagrange equation; constraints; coordinate transformations, mechanical gauge transformation; symmetries, Noether theorem, cyclic coordinates; accelerated reference systems and apparent forces;
3. Hamiltonian formulation: Legendre transformation, phase space; Hamilton function, canonical equations; Poisson brackets, canonical transformations; generator of symmetries, conservation laws; minimal coupling; Liouville theorem; Hamilton-Jacobi formulation [optional];
4. Applications: Central-force problems; mechanical similarity, Virial theorem; minor vibrations; particles in an electromagnetic field; rigid bodies, torque and inertia tensor, centrifugal and Euler equations [optional]; scattering, cross section [optional];
5. Relativistic dynamics: Lorentz Transformation; Minkowski space; equations of motion; 6. Non-linear dynamics: Stability theory; KAM theory [optional]; deterministic chaos [optional]

Intended learning outcomes

The students have gained first experiences concerning the working methods of Theoretical Physics. They are familiar with the principles of theoretical mechanics and their different formulations. They are able to independently apply the acquired mathematical methods and techniques to simple problems of Theoretical Physics and to interpret the results. They have especially acquired knowledge of basic mathematical concepts.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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

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

Module title			Abbreviation
Quantum Mechanics			11-T-Q-152-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	Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.	

Contents

1. History and basics: Limits of classical physics; fundamental historical experiments; from classical physics to quantum mechanics (QM);
2. Wave function and Schrödinger equation (SG): SG for free particles; superposition; probability distribution for pulse measurement; correspondence principles: postulates of QM; Ehrenfest theorem; continuity equation; stationary solutions of SG
3. Formalisation of QM: Eigenvalue equations; Physical significance of the eigenvalues of an operator; state space and Dirac notation; representations in state space; tensor products of state spaces;
4. Postulates of QM (and their interpretation): State; measurement; chronological development; energy-time uncertainty;
5. One-Dimensional problems: The harmonic oscillator; potential level; potential barrier; potential well; symmetry properties;
6. Spin-1/2 systems I: Theoretical description in Dirac notation; Spin 1/2 in the homogeneous magnetic field; two-level systems (qubits);
7. Angular momentum: Commutation and rotations; eigenvalues of the angular momentum operators (abstract); solution of the eigenvalue equation in polar coordinates (concrete);
8. Central potential - hydrogen atom: Bonding states in 3D; Coulomb potential;
9. Motion in an electromagnetic field: Hamiltonian; Normal Zeeman effect; canonical and kinetic momentum; Gauge transformation; Aharonov-Bohm effect; Schrödinger, Heisenberg and interaction representation; motion of a free electron in a magnetic field;
10. Spin-1/2 systems II: Formulation using angular momentum algebra;
11. Addition of angular momenta:
12. Approximation methods: Stationary perturbation theory (with examples); variational method; WKB method; time-dependent perturbation theory;
13. Atoms with several electrons: Identical particles; Helium atom; Hartree and Hartree-Fock approximation; atomic structure and Hund's rules

Intended learning outcomes

The students have gained first experiences concerning the working methods of Theoretical Physics. They are familiar with the principles of quantum theory. They are able to apply the acquired mathematical methods and techniques to simple problems of quantum theory and to interpret the results. They have especially acquired knowledge of advanced mathematical concepts.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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

Workload

240 h

Teaching cycle

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

Module title	Abbreviation
Statistical Physics	11-T-S-152-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

0. Principles of statistics; elements of statistics (central limit theorem and statistics of extremes); Micro- and macro-states; Probability space (conditional probability, statistical independence);
1. Statistical Physics: Entropy and probability theory; entropy in classical physics; thermodynamic equilibrium in closed and open systems (with energy and / or particle exchange);
2. Ideal systems: Spin systems; linear oscillators; ideal gas;
3. Statistical Physics and thermodynamics: The 1st law; quasi-static processes; entropy and temperature; generalised forces; the second and third law; reversibility; transition from Statistical Physics to thermodynamics;
4. Thermodynamics: Thermodynamic fundamentals relationship; thermodynamic potentials; changes of state; thermodynamic machines (Carnot engine and efficiency); chemical potential;
5. Ideal Systems II, quantum statistics: Systems of identical particles; ideal Fermi gas; ideal Bose gas and Bose-Einstein condensation; grids and normal modes: Phonons;
6. Systems of interacting particles: Approximation methods (mean-field theory, Sommerfeld expansion); computer simulation (Monte Carlo method); interacting phonons (Debye approximation); Ising models (particularities in 1 and 2 dimensions); Yang-Lee-theorems; Van der Waals equation for real interacting gases;
7. Critical phenomena: Scaling laws, critical slowing down, fast variable as Bad (electron-phonon interaction and BCS superconductivity); magnetism (quantum criticality at low temperatures, quantum phase transitions at T = 0); problems of the thermodynamic limit

Intended learning outcomes

The students have advanced knowledge of the methods of Theoretical Physics. They know the principles of statistical mechanics and thermodynamics. They are familiar with the corresponding mathematical methods and are able to independently apply them to the description and solution of problems in this area.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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

Module title			Abbreviation
Electrodynamics			11-T-E-152-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

0. Mathematical tools: Gradient, divergence, curl; curve, surface, volume integrals; Stokes and Gaussian sentence; Delta function; Fourier transform; full functional systems; solving PDEs;
1. Maxwell equations;
2. Electrostatics: Coulomb's law; electrostatic potential; charged interface; electrostatic field energy (capacitor); multipole expansion; Boundary value problems; numerical solution; Image charges; Green's functions; development according to orthogonal functions;
3. Magnetostatics: Current density; continuity equation; vector potential; Biot-Savart law; magnetic moment; analogies to electrostatics;
4. Maxwell equations in matter: Electrical and magnetic susceptibility; interfaces;
5. Dynamics of electromagnetic fields: Faraday induction; RCL-circuits; field energy and pulse; potentials; plane waves; wave packets; plane waves in matter; cavity resonators and wave guides; inhomogeneous wave equation; temporally oscillating sources and dipole radiation; accelerated point charges;
6. Special Theory of Relativity: Lorentz transform; simultaneity; length contraction and time dilation; light cone; effect, energy and momentum; co- and contra-variant tensors; covariant classical mechanics;
7. Covariant electrodynamics: Field strength tensor and Maxwell's equations; transformation of the fields; Doppler effect; Lorentz force

Intended learning outcomes

The students have advanced knowledge of the methods of Theoretical Physics. They know the principles of theoretical electrodynamics. They are familiar with the corresponding mathematical methods and are able to independently apply them to the description and solution of problems in this area.

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

V (4) + Ü (2)
Module taught in: Ü: German or English

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

written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places

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

Key Skills Area

(20 ECTS credits)

General Key Skills

(5 ECTS credits)

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

General Key Skills (subject-specific)

(ECTS credits)

Module title	Abbreviation
Exercise tutor or proof-reading in Mathematics	10-M-TuKo-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	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Tutoring or grading homework for one of the basic courses in the Bachelor's or teaching degree programmes under supervision of the respective lecturer or exercise supervisor.

Intended learning outcomes

The student is able to support the acquisition of mathematical skills and knowledge. He/She helps to identify mistakes in mathematical proof exercises and to find possible solutions.

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

T (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)

Assessment of tutoring activities or correcting work by supervising lecturers or exercise supervisors (1 to 2 teaching units or approx. 5 pieces of correcting work)

Allocation of places

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Additional information

Please direct application to teaching coordinator Mathematics, he/she will select participants.

Workload

150 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)

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

Module title	Abbreviation
E-Learning and Blended Learning Mathematics 1	10-M-VHB1-152-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)
2	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Becoming familiar with and reflecting techniques in e-learning and blended learning in mathematics.

Intended learning outcomes

The student is able to employ basic methods of e-learning and blended learning in mathematics-

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

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

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 (web-based, 15 to 20 hours)
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

60 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) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Economathematics (2025)

Module title	Abbreviation
E-Learning and Blended Learning Mathematics 2	10-M-VHB2-152-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)
2	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Becoming familiar with and reflecting techniques in e-learning and blended learning in mathematics.

Intended learning outcomes

The student is able to employ advanced methods of e-learning and blended learning in mathematics-

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

Ü (2)
Course type: eLearning, mostly Virtuelle Hochschule Bayern (vhb)

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 (web-based, 15 to 20 hours)
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

60 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) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Economathematics (2025)

Subject-specific Key Skills

(15 ECTS credits)

Subject-specific Key Skills, Compulsory Courses

(11 ECTS credits)

Module title			Abbreviation
Computational Mathematics			10-M-COM-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)**	
4	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Introduction to modern mathematical software for symbolic computation (e. g. Mathematica or Maple) and numerical computation (e. g. Matlab) to supplement the basic modules in analysis and linear algebra (10-M-ANA-G and 10-M-LNA-G). Computer-based solution of problems in linear algebra, geometry, analysis, in particular differential and integral calculus; visualisation of functions.

Intended learning outcomes

The student learns the use of advanced modern mathematical software packages, and is able to assess their fields of application to solve mathematical problems.

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

V (1) + 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)

project in the form of programming exercises (approx. 20 to 25 hours)
Language of assessment: German and/or English
Assessment offered: Once a year, winter semester

Allocation of places

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Additional information

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Workload

120 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Physics (2020)

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

Module title			Abbreviation
Programming course for students of Mathematics and other subjects			10-M-PRG-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)**	
3	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basics of a modern programming language (e. g. C).

Intended learning outcomes

The student is able to work independently on small programming exercises and standard programming problems in mathematics.

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

P (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)

project in the form of programming exercises (approx. 20 to 25 hours)
Language of assessment: German and/or English
Assessment offered: Once a year, summer semester

Allocation of places

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Additional information

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Workload

90 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Nanostructure Technology (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Functional Materials (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Functional Materials (2021)

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

Module title	Abbreviation
Basic Notions and Methods of Mathematical Reasoning	10-M-GBM-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)
2	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Introduction to the basic notions and proof techniques in mathematics: approach to sets, formal logic and maps.

Intended learning outcomes

The student gets acquainted with the basic working techniques which are prerequisites for the further courses in the Bachelor's degree study programme.

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

V (1) + Ü (1)

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 (10 to 15 pages)
Language of assessment: German and/or English

Allocation of places

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Additional information

Additional information on module duration: block taught prior to the beginning of the lecture period.

Workload

60 h

Teaching cycle

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

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)

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

Module title			Abbreviation
Reasoning and Writing in Mathematics			10-M-ASM-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)**	
2	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Introduction to fundamental methods of thinking and proving, basic techniques in mathematics as well as mathematical writing;insight into examples of abstracts concepts in mathematics; approach to axiomatic and deduction.

Intended learning outcomes

The student is acquainted with the basic proof methods and techniques in mathematics. He/She is able to perform easy mathematical arguments independently and present them adequately and reasonably in written and oral form.

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

V (1) + Ü (1)

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 (10 to 20 pages)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

60 h

Teaching cycle

--

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

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Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)

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

Subject-specific Key Skills, Compulsory Electives

(4 ECTS credits)

Module title			Abbreviation
Supplementary Seminar Mathematics			10-M-SEM2-152-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)**	
4	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

A selected topic in mathematics.

Intended learning outcomes

The student gains first experience with independent scientific work. He/She masters elaboration and structuring of a given topic using selected literature, and prepares a talk on the subject. He/She is able to participate actively in a scientific discussion.

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

S (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)

talk (60 to 120 minutes)
Language of assessment: German and/or English

Allocation of places

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Additional information

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Workload

120 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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Introduction to Stochastic Financial Mathematics			10-M-EFM-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)**	
9	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Arbitrage and no-arbitrage, annuities and bonds, valuation of deterministic cash flows, actuarial present value, term structures and yield curves, forwards, payout profiles of options and other derivates, fundamental theorem of asset pricing in the stochastic one-period model, risk neutral price measures, replication and completeness, stochastic multi-period models, valuation of European options in the binomial model, Black-Scholes formula.

Intended learning outcomes

The student is acquainted with the fundamental concepts and methods of stochastic financial mathematics, can apply them to practical problems and knows about typical fields of application.

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

V (4) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Workload

270 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) Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Economathematics (2017)
Bachelor's degree (1 major) Economathematics (2021)
Bachelor's degree (1 major) Economathematics (2022)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Economathematics (2023)
Bachelor's degree (1 major) Economathematics (2024)
Bachelor's degree (1 major) Economathematics (2025)

Module title	Abbreviation
Introduction to Topology	10-M-TOP-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	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Basics in set-theoretic topology, topological spaces and continuity, separation properties, connectivity, examples and constructions of topological spaces, quotients, convergence of sequences and nets, different notions of compactness, additional topics (optional), e. g. the theorems of Stone-Weierstraß, Arzela-Ascoli and Baire, and introduction to algebraic topology.

Intended learning outcomes

The student knows the fundamental concepts and methods of topology as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to topology, and realises the broad applicability of the theory to other branches of mathematics.

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

V (2) + Ü (2)

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

a) written examination (approx. 90 to 180 minutes, usually chosen) or
b) oral examination of one candidate each (15 to 30 minutes) or
c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester
creditable for bonus

Allocation of places

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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) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title	Abbreviation
Selected Topics in History of Mathematics	10-M-GES-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	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Historical and cultural development as well as social relevance of mathematics; more in-depth discussion of the fundamentals of mathematics, in particular in its relation to other sciences and humanities as well as to the image of mathematics in modern society.

Intended learning outcomes

Based on selected examples, the student has gained insight into the historical and cultural genesis of mathematical theories and their social relevance. He/she is able to present mathematical ideas and concepts to a general audience.

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

V (2) + Ü (2)

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

a) talk (45 to 90 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
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

150 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

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

Module title			Abbreviation
Mathematical Writing			10-M-MSC-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	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Discussion of good and bad mathematical writing using practical exercises and case examples. The course covers the whole range of mathematical texts from short proofs and the formulation of theorems and definitions to comprehensive works such as Bachelor's or Master's theses. Important aspects include not only mathematical rigour and efficiency but also didactic questions.

Intended learning outcomes

The student is able to formulate mathematical subject matter precisely and comprehensibly. He/She knows about the structures and conventions of mathematical literature and the requirements of scientific work.

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

V (2) + Ü (2)

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

a) talk (45 to 90 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
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

150 h

Teaching cycle

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

§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)

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

Module title	Abbreviation
School Mathematics from a Higher Perspective	10-M-SCH-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	(not) successfully completed	--

Duration	Module level	Other prerequisites
1 semester	undergraduate	--

Contents

Discussion of selected topics in school mathematics with respect to their integration into wider theories and their didactic implementation at both school and university levels.

Intended learning outcomes

By means of selected examples, the student gains insight into the interrealtion between school mathematics and advanced mathematical theories. He/She is able to discuss these under mathematical, didactical and methodical aspect.

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

V (2) + Ü (2)

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

a) talk (approx. 45 minutes) or
b) term paper (10 to 15 pages) or
c) project work (15 to 25 hours)
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

150 h

Teaching cycle

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

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)

Module appears in

Bachelor's degree (1 major) Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2015)
Bachelor's degree (1 major) Computational Mathematics (2015)
First state examination for the teaching degree Grundschule Mathematics (2015)
First state examination for the teaching degree Realschule Mathematics (2015)
First state examination for the teaching degree Gymnasium Mathematics (2015)
First state examination for the teaching degree Mittelschule Mathematics (2015)
Bachelor's degree (1 major) Mathematical Physics (2016)
First state examination for the teaching degree Gymnasium Mathematics (2019)

First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Mathematical Data Science (2022)
exchange program Mathematics (2023)
First state examination for the teaching degree Gymnasium Mathematics (2023)
Bachelor's degree (1 major) Mathematics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation
Proseminar Mathematics			10-M-PRO-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)**	
4	(not) successfully completed	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Selected basic topics in mathematics.

Intended learning outcomes

The student gains first experience with independent scientific work. He/She masters elaboration and structuring of a given topic using selected literature, and prepares a talk on the subject. He/She is able to participate actively in a scientific discussion.

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

S (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)

talk (60 to 120 minutes)
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered

Allocation of places

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Additional information

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Workload

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

Thesis

(11 ECTS credits)

Module title			Abbreviation
Bachelor Thesis Computational Mathematics			10-M-BAC-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)**	
11	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	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 bachelor 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)

Bachelor's thesis (approx. 275 to 330 hours)

Allocation of places

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Additional information

Time to complete: 10 weeks.

Workload

330 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) Computational Mathematics (2015)