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Mathematisch-
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Department of Mathematik

Module Handbook

Computer Science – Physics – Mathematics

Master of Education

Quereinstieg Lehramt Gymnasium*

Winter Semester 2026

Last updated on 14th July 2026

*This is a secondary school teaching degree with a major in two of the three subjects computer science, physics and mathematics. The module handbook is valid for the 2026 study and examination regulations.

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1 Description of Study Programme

1.1 Basic Information about the Study Programme

1.1.1 Fundamentals

In a letter dated 14 August 2018, the Ministry of Science, Research and the Arts called on the universities in Baden-Württemberg to allow access to the Master of Education programme in computer science and physics with a Bachelor's degree without teaching-related elements in order to counteract the acute shortage of teachers in both subjects. Mathematics is listed as a suitable second subject in the letter. This module handbook describes the study programme concept of the University of Tübingen for a separate Master of Education Teacher Training for Secondary School in the three subject combinations Computer Science-Mathematics, Computer Science-Physics and Mathematics-Physics for graduates with a Bachelor of Science degree without teaching-related components in one of the three subjects with substantial components in the chosen second subject.

The achievements of this study programme are designed in such a way that the graduates of the study programme, in combination with the achievements acquired in their Bachelor of Science degree programme, have essentially acquired the competences to be acquired in a regular consecutive teacher training course and that the content requirements of the Framework Ordinance for Teacher Training Courses (RahmenVO-KM) of 27 April 2015 have been met, as required in the letter from the Ministry.

1.1.2 Study Objective

The study programme leads to the degree Master of Education lateral entry for secondary school with one of the following subject combinations

- Computer Science and Mathematics,
- Computer Science and Physics or
- Mathematics and Physics

on the basis of the letter from the Ministry of Science, Research and the Arts dated 14 August 2018 for admission to the preparatory service for secondary school teaching in Baden-Württemberg, and it enables access to the teaching profession in the state of Baden-Württemberg after successful completion of the preparatory service. However, it must be pointed out that it cannot be guaranteed that the qualification will entitle the holder to preparatory service or subsequent employment in the teaching profession in another federal state.

1.1.3 Admission Requirements

Applicants who have completed a Bachelor of Science degree in *Computer Science* at the University of Tübingen with a grade of 2.5 or better or a degree in a related study programme with essentially

the same content and qualification aims at a university may be admitted to the Master of Education Quereinstieg Lehramt Gymnasium with the subject combinations *Computer Science and Mathematics* or *Computer Science and Physics* if they fulfil the requirements set out in section 2.3 or comparable achievements in the respective second subject of Mathematics or Physics.

Applicants who have completed a Bachelor of Science degree in *Mathematics* at the University of Tübingen with a grade of 2.5 or better or a degree in a related study programme with essentially the same content and qualification aims at a university may be admitted to the Master of Education Quereinstieg Lehramt Gymnasium with the subject combinations *Mathematics and Computer Science* or *Mathematics and Physics* if they fulfil the requirements set out in section 2.3 or comparable achievements in the respective second subject of Computer Science or Physics.

Applicants who have obtained a Bachelor of Science degree in *Physics* at the University of Tübingen with a grade of 2.5 or better or a degree in a related study programme with essentially the same content and qualification aims at a university may be admitted to the Master of Education Quereinstieg Lehramt Gymnasium with the subject combinations *Physics and Computer Science* or *Physics and Mathematics* if they fulfil the requirements set out in the section 2.3 or comparable achievements in the respective second subject Computer Science or Mathematics.

If a maximum of 30 credit points (CP) are missing from the additional achievements required in the second subject, admission may be granted subject to a condition. Proof of the missing credits must then be provided by the time of registration for the Master's thesis.

In addition to the previously listed admission requirements, proof of participation in a study orientation procedure for teacher education students (teacher orientation test) must be provided. Further information can be found on the university's website for study orientation procedures.

1.1.4 Structure of the Study Programme

Starting a Master's degree programme in teaching with a Bachelor's degree without teaching-related components means that the study requirements of students will vary greatly from student to student. This requires individual counselling for each and every student with regard to the structure and design of their degree programme. All students on this degree programme should therefore attend a study consultation with the Faculty Course Advisor for the teaching degree in their chosen second subject at the beginning of their studies and discuss an individual study plan with the advisor, that takes into account the previous knowledge and special circumstances of the respective student.

1.1.5 Time Frame for Studying Abroad

It is not possible to specify a specific time frame for a study component at a foreign university for this degree programme, as the study structure will be too individual and different. This can only be planned in a personal counselling interview with the Faculty Course Advisor.

1.2 Qualification Objectives

As part of the teaching-related Master's degree programme Master of Education Quereinstieg Lehramt Gymnasium – Informatik, Physik, Mathematik graduates acquire fundamental and in-depth subject-specific and subject-related didactic knowledge and skills in the chosen subject combination, as required necessary for science-based teaching at secondary schools. These enable them to carry out

targeted teaching, learning and educational processes in the selected subjects and to independently integrate new subject-specific and subject-linking developments into teaching and school development independently.

1.2.1 Qualification Objectives in Computer Science

Graduates have the following competences:

- They are able to recognise, evaluate and explain computer science issues in various application contexts and factual contexts as well as social effects.
- They are able to analyse and structure real-life situations in order to make them accessible for processing using computer science methods.
- They can transfer computer science-specific content concepts and process concepts to other fields of application and use their acquired computer science skills in non-computer science contexts.
- They know the longevity and transferability of central computer science concepts.
- They are familiar with the various perspectives and working methods of computer science, from engineering approaches such as analysis and design, to mathematical methods for gaining knowledge such as formalisation and proof, to social science and empirical methods such as experimentation and simulation.
- They can convey computer science concepts such as data modelling and data structuring when using standard applications (text, image, audio, video editors, spreadsheets).
- They can characterise computer science as a discipline and reflect on the function and image of computer science and computer science education in society.
- They can reflect on current development trends in school computer science, evaluate the content and represent a critical openness with regard to new developments in computer science.
- They can establish links between their specialised knowledge and school computer science.

1.2.2 Qualification Objectives in Mathematics

Graduates are familiar with the basic problems in linear algebra, analysis, numerical mathematics, stochastics, geometry and algebra and have mastered the central techniques for solving them. They acquire basic mathematical thinking patterns such as structuring problems, creating argumentation chains and finally proving mathematical theorems. Graduates are able to communicate mathematical facts, use suitable media and establish links to school mathematics.

Graduates are proficient in the theoretical explanatory approaches as well as in principles and methods in mathematics. They are able to give exemplary descriptions of the current state of research and are able to critically scrutinise this. Graduates can apply their in-depth knowledge to develop and solve their own simple research ideas. They will be able to derive, analyse, prove and interpret specific questions from general mathematical concepts. Graduates can explain and discuss the results of their research work in depth to a scientific audience, both in writing and orally.

1.2.3 Qualification Objectives in Physics

Graduates are familiar with the fundamental issues of classical and modern physics and have mastered the basic working and cognitive methods of physics. They are familiar with the fundamental concepts, modelling and approaches of physics. They can formulate simple physical problems mathematically and solve them exactly or approximately. They can explain the social significance of physics and evaluate social discussions and developments from a physical point of view.

Graduates have specialised knowledge of physics that enables them to plan student-oriented lessons. They are able to follow recent physics research in overview presentations and introduce suitable new topics into the classroom. They are able to set up and carry out teacher and student experiments. Students understand the fundamental ways of thinking in modern physics and are able to describe the transition from classical to modern physics, also in a historical context. They are able to carry out experiments and know the relevant underlying methods of analysis and interpretation. They are able to independently find solutions to physical problems and can apply the essential principles of physics to solve specific tasks. To do so, they are familiar with the basic concepts and methods of mathematics for describing physical facts.

Students are able to communicate the ways of thinking and working in physics in an understandable way and enable active participation in social development through their physics education.

1.2.4 Qualification Objectives in Subject-Didactics

Graduates combine their subject-specific knowledge with didactic methods, use suitable media and are able to use theoretical concepts and empirical findings from subject-related teaching and learning research to analyse thought processes and ideas of pupils in approaches and to guide individual learning processes. They know and evaluate the concepts for learning and teaching the chosen subjects at school on the basis of didactic theories and empirical findings. They can analyse and plan subject lessons in the selected subjects with heterogeneous learning groups on the basis of subject didactic concepts. Graduates are familiar with gender-specific aspects of their subjects and are able to plan lessons didactically and methodically in a gender-appropriate way. They are able to explain the fundamental educational value of subject-related content and methods as well as the social significance of the chosen subjects and place them in the context of the objectives and content of the lessons.

They have mastered the didactic concepts of student-oriented teaching. They have gained initial reflective experience in planning, designing and implementing competence-oriented lessons and are able to cooperate with colleagues from other science subjects in order to plan coordinated lessons.

1.2.5 Qualification Objectives in the Educational Sciences

The Educational Science study programme (BWS) as part of the Master's degree programme for lateral entry to teaching computer science, physics and mathematics at secondary schools prepares graduates for a scientifically sound and professional career in schools and teaching. Graduates learn about fundamental and in-depth educational science issues. Through the academic introduction to the school internship semester and its reflection, graduates are able to reflect academically on their practical school experience.

The overarching objective of the degree programme is to support students in developing their educational science knowledge and their educational science skills and abilities. They acquire

professional knowledge and expand their professional skills, analyse and reflect on their professional development on the basis of scientific theories, methods and empirical findings and use the portfolio as an instrument to document their competence-related and reflective professional development.

The framework regulation for teacher training formulates a competence profile in the educational sciences (Kultus und Unterricht of 13 July 2015, p. 287): *Graduates have professional competences and know the importance of contemporary education. They are familiar with educational science and psychology, as well as sociological, theological, philosophical, ethical and political science aspects of education. They know the Christian and Western educational and cultural values. At the same time, they take into account age-appropriate forms of teaching, principles of education for sustainable development, media pedagogical and gender-related findings and attach particular importance to the development of personal skills. They are able to co-operate with parents, promote intercultural competence and have diagnostic and support skills, particularly with regard to integrative and inclusive educational programmes. On this basis, they are able to organise and reflect on their educational activities. The teacher training programme guides them to develop their profession, analyse their own professional development and their future work at school on the basis of research findings. Graduates have the competence, commensurate with their level of training, to design student-oriented lessons that are characterised by appreciation and professionalism. Graduates have basic knowledge of how to organise lessons in a motivating and individually supportive way, even in heterogeneous learning groups. They see themselves as responsible actors in the education system and are familiar with the social and political framework for their actions. They have basic research methodological skills in order to analyse their actions in lessons and schools and to be able to interpret relevant research results appropriately and critically. Graduates understand the need to continuously develop their professional skills and to make use of the support and counselling services offered by institutionalised teacher training for their professional development.*

This makes it clear that students in teaching are confronted with a broad educational policy horizon that places multiple demands on teacher training in educational science. In order to prepare students for these requirements in the educational science degree programme (BWS), it cannot be the aim of the university degree programme to technically practise later professional activities nor to place directly usable skills at the centre of the discussion. Instead, flexible skills and abilities must be acquired based on knowledge. The repeatedly expressed desire for greater practical relevance in the sense of imparting practical and professional knowledge may be understandable in view of the later professional profile, but ultimately falls short: teaching and learning processes in schools and lessons are highly complex, cannot be standardised and normed and always take place in specific contexts. Prescriptive approaches cannot do justice to these processes and contradict the development of a balanced and professional attitude towards new economic, social, political or cultural developments. The teaching profession in particular is a profession that is constantly and very directly confronted with diverse social developments and has to deal with the expectation of analysing such changes on the basis of scientific findings, reflecting critically on them and, under certain circumstances, taking them up in professional action. Despite these objections to praxeological work in the study programme, the question of whether the content and skills taught in educational science studies are relevant to practice and action for graduates can be affirmed with certainty. However, their relevance is not limited to this. The degree programme does not prescribe specific actions in certain situations, but offers the potential to develop skills for analysing, criticising and developing any practice in schools and lessons and to provide well-founded categories, theories and methods. Students are expected to acquire relevant knowledge and flexible skills and abilities in the competency areas of a) teaching, b) educating, c)

assessing, and d) innovating (specification of the Ministry of Education and Cultural Affairs: Kultus und Unterricht of 13 July 2015, p. 291-292; see also portfolio work) acquire the relevant knowledge and flexible skills and abilities that are required for successful and reflective teacher behaviour in practical school situations.

The Educational Science degree programme (BWS) offers a systematic approach to the micro, meso and macro levels of schooling. The School Internship Semester is prepared and followed up with references to theories and empirical research findings and reflected on through case work in the portfolio. The Inclusion, Diversity and Heterogeneity module focuses on linguistic heterogeneity. The module Empirical Educational Research and Educational Psychology introduces basic questions of empirical educational research and key educational-psychological topics for the teaching profession.

2 Study Plans

2.1 Overview by Modules

Here we provide an overview of the modules that can be taken in the individual areas of study depending on the chosen combination of subjects and the creditable prior achievements. Detailed information on the programme structure and the study plans in the various combination options can be found below.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Computer Science							
3-4	INFL20	Elective Module I	L+P	PMW		wr. o. or.	6
1-4	INFM2111	Practical Computer Science 3: Software Engineering	L+E	PMW	EC	wr.	6
1-3	INFM2310	Computer Engineering 2: Computer Science of Systems	L+E	PM	EC	wr.	9
1-3	INFM2410	Theoretical Computer Science 2: Formal Languages, Computability, and Complexity	L+E	PM	EC	wr.	9
1-3	INFM2420	Theoretical Computer Science 1: Algorithms and Data Structures	L+E	PM	EC	wr.	9
3-4	INFM3110	Elective Subject in Practical Computer Science	L+P	PMW		wr. o. or.	6
3-4	INFM3310	Elective Subject in Computer Engineering	L+P	PMW		wr. o. or.	6
3-4	INFM3410	Elective Subject in Theoretical Computer Science	L+P	PMW		wr. o. or.	6
Section 2: 2nd Subject Mathematics							
1-4	MAT-20-05	Compulsory Intermediate Modules Analysis		PM		or.	13.5
		- Measure and Integration Theory	L+E		EC		
		- Introduction to ODE	L+E		EC		
		- Introduction to Complex Analysis	L+E		EC		
1-4	MAT-20-06	Compulsory Intermediate Modules Algebra and Geometry		PM		or.	13.5
		- Algebraic Structures	L+E		EC		
		- Introduction to Galois Theory	L+E		EC		
		- Introduction to Geometry	L+E		EC		
1-4	MAT-20-12	Stochastics	L+E	PM	EC	wr. o. or.	9
1-4	MAT-20-13	Numerical Mathematics		PM		wr. o. or.	6

		- Introduction to Numerical Mathematics	L+E		EC		
		- Mathematical Software	P		PC		
2-4	MAT-20-20	Introductory Seminar: Presentations in Mathematics	PS	PMW	s.M.	Pr	3
Section 3: 2nd Subject Physics							
1-2	BLP102	Physics Basic Analytical Mechanics	L+E	PM	EC	wr. o. or.	6
1-2	BLP103	Physics Basic Course Optics and Advanced Study		PM		wr. o. or.	9
		- Physics Basic Course Optics	L+E		EC		
		- Advanced Studies	L				
2-3	BLP104	Modern Physics A	L+E	PMW	EC	wr.	12
1-2	BLP105A	Physics Laboratory A	P	PM	s.M.	-	6
2-3	BLP106BD	Physics Laboratory B and Demonstration Laboratory	P+P	PM	-	-	6
3-4	MLP114	Modern Physics D	L+L	PMW		wr.	6
Section 4: Didactics							
1-2	INFL01	Subject Didactics in Computer Science I	S	PM	s.M.	K o. mP o. R o. H	3
2-3	INFL02	Subject Didactics in Computer Science II	L+E	PM		K o. mP o. R o. H	6
3-4	INFL03a	Subject Didactics in Computer Science IIIa (MEd IPM)	S	PM	s.M.	K o. mP o. R o. H	3
1-2	MAT-80-01	Subject Didactics Mathematics 1	LIC	PM	s.M.	wr., or., P o. T	3
2-3	MAT-80-04	Subject Didactics Mathematics 2 (MEd-IPM)	SV	PM	s.M.	K o. mP o. R o. H	3
3-4	MAT-80-05	Subject Didactics Mathematics 3: Professional Knowledge	S	PM	s.M.	K o. mP o. R o. H	3
3-4	MAT-80-06	Subject Didactics Mathematics 3: Elective Specialisation	S	PMW	s.M.	K o. mP o. R o. H	3
1-2	BLP105F	Subject Didactics in Physics 1	S	PM	s.M.	wr. o. or.	3
2-3	BLP106F	Subject Didactics Physics 2	S	PM	s.M.	wr. o. or.	3
2-3	BLP106S	Subject Didactics in Physics 3 (MEd-IPM)	S,P	PM	s.M.	wr. o. or.	3
3-4	MLP10F	Subject Didactics in Physics 4	SÜ	PM	s.M.	-	3
3-4	MLP12F	Subject Didactics in Physics 5	SÜ	PM	s.M.	wr. o. or.	3
Section 5: Education							
1-2	BWS-ME0	Educational Sciences 1 (MEd-IPM)	L+S	PM	-	wr. o. or.	5
1-2	BWS-ME1	School Pedagogy I	S+S	PM	-	mP o. K	6

2-3	BWS-ME3	Inclusion, Diversity, and Heterogeneity	L+L	PMW	-	wr.	6
3-4	BWS-ME4	Empirical Educational Research and Educational Psychology	L	PM	-	wr.	6
Section 6: School Practise Semester							
2-3	SP	School Practice Semester	-	PM	s.M.	-	16
Section 7: Master Thesis							
4	INFL31	Master Thesis Computer Science	MT	PM	s.M.	MT	15
4	MAT-40-54	Master Thesis	MT	PM	s.M.	MT	15
4	MLP13	Master Thesis (Physics)	MT	PM	s.M.	MT	15
Section 8: Requirements							
-	BLP01	Physics Basic Course 1	L+E	PM	EC	wr.	12
-	BLP02	Physics Basic Course 2	L+E	PM	EC	wr.	12
-	INFM1010	Mathematics for Computer Science 1: Analysis	L+E	PM	EC	wr.	9
-	INFM1020	Mathematics for Computer Science 2: Linear Algebra	L+E	PM	EC	wr.	9
-	INFM1110	Practical Computer Science 1: Declarative Programming	L+E	PM	EC	wr.	9
-	INFM1120	Practical Computer Science 2: Imperative and Object-Oriented Programming	L+E	PM	EC	wr.	9
-	INFM2010	Mathematics for Computer Science 3: Advanced Topics	L+E	PM	EC	wr.	9
-	MAT-10-10	Foundations of Mathematics		PM		or.	27
		- Foundations of Mathematics 1	L+E+T		EC		
		- Foundations of Mathematics 2	L+E+T		EC		
		- Exploring Mathematics	P		PC		
-	MP1	Mathematics for Physicists 1	L+E	PM	EC	wr.	9
-	MP2	Mathematics for Physicists 2	L+E	PM	EC	wr.	9

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.2 Basic Programme Structure

The following table shows how the credit points are distributed across the different areas of study.

Number	Study Area	Credit Points (CP)
0	First Subject	0 CP
1–3	Second Subject	45 CP
4	Subject Didactics (1st+2nd Subject)	21 CP
5	Education Science	23 CP
6	School Practice Semester	16 CP
7	Master Thesis	15 CP
	Sum	120 CP

2.3 Programme Structure in Study Area Second Subject

In the following sections, the expected preliminary work in the second Subject and the modules to be completed are listed in tabular form for the various subject combinations, in each case indicating the first and second Subject.

2.3.1 Degree B.Sc. Computer Science, 2nd Subject Mathematics

For the second subject Mathematics, the following prior achievements from the Bachelor of Science Computer Science degree programme at the University of Tübingen or comparable achievements from another degree programme justifying admission to the degree programme are required.

Preliminary work for the second subject Mathematics*	
Mathematics for Computer Science 1: Analysis (INFM1010)	9 CP
Mathematics for Computer Science 2: Linear Algebra (INFM1020)	9 CP
Mathematics for Computer Science 3: Advanced Topics (INFM2010)	9 CP
Sum	27 CP

The following modules must be completed in the second subject area. These are entire modules from the subject Mathematics in the Bachelor's and Master's of Education Lehramt Gymnasium degree programmes.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Mathematics							
1-4	MAT-20-06	Compulsory Intermediate Modules Analysis		PM		Or.	13,5*
		- Measure and Integration Theory	L+E		EC		
		- Introduction to ODE	L+E		EC		
		- Introduction to Complex Analysis	L+E		EC		
1-4	MAT-20-06	Compulsory Intermediate Modules Algebra and Geometry		PM		Or.	13,5*
		- Algebraic Structures	L+E		ÜN		
		- Introduction to Galois Theory	L+E		EC		
		- Introduction to Geometry	L+E		EC		
1-4	MAT-20-12	Stochastik	L+E	PM	EC	Wr. o. Or.	9*
1-4	MAT-20-13	Numerical Mathematics**	L+E	PM	EC	Wr. o. Or.	6*
1-4	MAT-20-20	Introductory seminar	PS	PMW	s.M.	Pr	3
						Summe	45 CP

*All information provided here refers to the study and examination regulations of the University of Tübingen for the Computer Science degree programme with academic final examination Bachelor of Science (B. Sc.) in the version of 25.03.2021 (Amtl.Bek.UT 10/2021, p. 293) or the study and examination regulations and Examination Regulations of the University of Tübingen for the Mathematics degree programme with academic Bachelor of Science (B. Sc.) degree programme in the version dated 5 August 2019 (Amtl.Bek.UT 15/2019, p. 443); the relevant examination board decides on the recognition of other achievements.

* If the competences of the module or of a submodule have already been acquired, to a large extent, in the Bachelor's programme that entitles the student to admission to this programme, the (sub)module must be replaced by another achievement in consultation with the Chair of the Examination Board. This must be clarified and determined as part of the admission process.

** The module Numerical Analysis may, upon application to the Chair of the Examination Board, be replaced by the module Mathematics for Computer Science 4: Numerical Analysis. The latter is offered in the summer semester, which makes the study plan more flexible.

Abbreviations:

Type of Module	: PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work	: EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other	: h=hours, o.=or, s.M.=see module description, ST=suggested term

2.3.2 Degree B.Sc. Computer Science, second Subject Physics

For the second subject Physics, the following prior achievements from the Bachelor of Science Computer Science degree programme at the University of Tübingen or comparable achievements from another degree programme justifying admission to the degree programme are required.

Prerequisites for the second subject Physics†	
2of the 3 modules Mathematics for Computer Science 1-3 (INFM1010, INFM1020, INFM2010)	$\geq$ 12 CP
Physics Basic Course 1 (PGK1)	12 CP
Physics Basic Course 2 (PGK2)	12 CP
Sum	36 CP
The modules Physics Basic Course 1 and Physics Basic Course 2 can be completed in the Bachelor of Science Computer Science degree programme at the University of Tübingen in the area of specialisation with 18 CP.	

The following modules must be completed in the 2nd subject area. These are entire modules from the subject of physics in the Bachelor's and Master's of Education Lehramt Gymnasium degree programmes.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Physics							
Section 1: 2. Fach Physik							
1-2	BLP102	Physics Basic Course Analytical Mechanics	L+E	PM	EC	Wr.	9
1-2	BLP103	Physics Basic Course Optics and Advanced Study	L+E	PM	EC	Wr.	9
2-3	BLP104	Modern Physics A*	L+E	PM	EC	Wr.	12
1-2	BLP105A	Physics Laboratory A	P	PM	s.M.	-	6

†All information provided here refers to the study and examination regulations of the University of Tübingen for the degree programme Computer Science with academic final examination Bachelor of Science (B. Sc.) in the version of 25.03.2021 (Amtl.Bek.UT 10/2021, p. 293) or the study and examination regulations of the University of Tübingen for the degree programme Physics with academic final examination Bachelor of Science (B. Sc.) in the version dated 30 July 2013 (Amtl.Bek.UT 16/2013, p. 787); the responsible examination board decides on the recognition of other achievements.

2-3	BLP106BD	Pysics Laboratory B + Demonstration Laboratory	P	PM	s.M.	-	6
3-4	MLP114	Modern Physics D	L+E	PM	EC	Or.	6
						Sum	45 CP

* The module Modern Physics A may also be completed by successful participation in the Basic Module Quantum Mechanics from the Bachelor of Science – Physics programme (9 CP), together with completion of the requirements for the component Molecules, Atom, Light within the module Modern Physics A. As the Basic Module Quantum Mechanics is offered in the summer semester, this route may allow for a more suitable study plan. Both the module Modern Physics A and the Basic Module Quantum Mechanics require basic knowledge of analytical mechanics, which is taught, e.g. in the module Basic Physics: Analytical Mechanics. Replacement of the module Modern Physics A should only take place in consultation with the Faculty Course Adviser.

Abbreviations:

Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.3.3 Degree B.Sc. Mathematics, second Subject Computer Science

For the second subject Computer Science, the following prior achievements from the Bachelor of Science Mathematics degree programme at the University of Tübingen or comparable achievements from another degree programme justifying admission to the degree programme are required.

Prerequisites for the second subject Computer Science‡	
Analysis (MAT-10-01)	9 CP
Practical Computer Science 1: Declarative Programming (INFM1110)	9 CP
Practical Computer Science 2: Imperative and Object-Oriented Programming (INFM1120)	9 CP
Sum	27 CP
The modules Practical Computer Science 1 and Practical Computer Science 2 can be completed in the Bachelor of Science Mathematics degree programme at the University of Tübingen as part of the section Elective Specialisation.	

The following modules must be completed in the 2nd subject area. These are entire modules from the subject Computer Science in the Bachelor's or Master's of Education Lehramt Gymnasium programmes.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Computer Science							
1-4	INFM2111	Practical Computer Science 3: Software Engeneering	L+E	PM	EC	Wr.	6
1-3	INFM2310	Computer Engeneering 2: Computer Science of Systems	L+E	PM	EC	Wr.	9

‡All information provided here refers to the study and examination regulations of the University of Tübingen for the degree programme Computer Science with academic final examination Bachelor of Science (B. Sc.) in the version dated 23 May 2021 (Amtl.Bek.UT 10/2021, p. 293) or the study and examination regulations of the University of Tübingen for the degree programme Mathematics with academic final examination Bachelor of Science (B. Sc.) in the version dated 05.08.2019 (Amtl.Bek.UT 15/2019, p. 443); the responsible examination board decides on the recognition of other achievements.

1-3	INFM2410	Theoretical Computer Science 2: Formal languages, computability and complexity	L+E	PM	EC	Wr.	9
1-3	INFM2420	Theoretical Computer Science 1: Algorithms and Data Structures	L+E	PM	EC	Wr.	9
3-4	INFL20	Compulsory Elective Module I	L+E	PMW	EC	Wr. o. Or.	6
3-4	INFM3110	Elective Subject Practical Computer Science	L+P	PMW		Wr. o. Or.	6*
3-4	INFM3310	Elective Subject Computer Engeneering	L+P	PMW		Wr. o. Or.	6*
3-4	INFM3410	Elective Subject Theoretical Computer Science	L+P	PMW		Wr. o. Or.	6*
						Sum	45 CP

*Only one of the compulsory elective modules Practical Computer Science, Computer Engineering and Theoretical Computer Science needs to be taken.

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.3.4 Degree B.Sc. Mathematics, second Subject Physics

For the second subject Physics, the following prior achievements from the Bachelor of Science Mathematics degree programme at the University of Tübingen or comparable achievements from another degree programme justifying admission to the degree programme are required.

Prerequisites for the second subject Physics[§]	
Foundations of Mathematics (MAT-10-10-1)	$\geq$ 12 CP
Physics Basic Course 1 (PGK1)	12 CP
Physics Basic Course 2 (PGK2)	12 CP
Sum	36 CP
The modules Physics Basic Course 1 and Physics Basic Course 2 can be completed in the Bachelor of Science Mathematics degree programme at the University of Tübingen as part of the section Elective Specialisation.	

The following modules must be completed in the 2nd subject area. These are entire modules from the subject of physics in the Bachelor's and Master's of Education Lehramt Gymnasium degree programmes.

[§]All information provided here refers to the study and examination regulations of the University of Tübingen for the degree programme Physics with academic final examination Bachelor of Science (B. Sc.) in the version of 30 July 2013 (Amtl.Bek.UT 16/2013, p. 787) or the study and examination regulations of the University of Tübingen for the degree programme Mathematics with academic final examination Bachelor of Science (B. Sc.) in the version dated 05.08.2019 (Amtl.Bek.UT 15/2019, p. 443); the responsible examination board decides on the recognition of other achievements.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Physics							
Section 1: 2. Fach Physik							
1-2	BLP102	Physics Basic Course Analytical Mechanics	L+E	PM	EC	Wr.	9
1-2	BLP103	Physics Basic Course Optics and Advanced Study	L+E	PM	EC	Wr.	9
2-3	BLP104	Modern Physics A*	L+E	PM	EC	Wr.	12
1-2	BLP105A	Physics Laboratory A	P	PM	s.M.	-	6
2-3	BLP106BD	Pysics Laboratory B + Demonstration Laboratory	P	PM	s.M.	-	6
3-4	MLP114	Modern Physics D	L+E	PM	EC	Or.	6
						Sum	45 CP

* The module Modern Physics A may also be completed by successful participation in the Basic Module Quantum Mechanics from the Bachelor of Science – Physics programme (9 CP), together with completion of the requirements for the component Molecules, Atom, Light within the module Modern Physics A. As the Basic Module Quantum Mechanics is offered in the summer semester, this route may allow for a more suitable study plan. Both the module Modern Physics A and the Basic Module Quantum Mechanics require basic knowledge of analytical mechanics, which is taught, e.g. in the module Basic Physics: Analytical Mechanics. Replacement of the module Modern Physics A should only take place in consultation with the Faculty Course Adviser.

Abbreviations:

Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.3.5 Degree B.Sc. Physics, second Subject Computer Science

For the second subject Computer Science, the following prior achievements from the Bachelor of Science Physics degree programme at the University of Tübingen or comparable achievements from another degree programme justifying admission to the degree programme are required.

Prerequisites for the second subject Informatik[¶]	
Mathematics for Physicists 1 (MP1)	9 CP
Practical Computer Science 1: Deklarative Programming (INFM1110)	9 CP
Practical Computer Science 2: Imperative and Object-Oriented Programming (INFM1120)	9 CP
Sum	27 CP
The modules Practical Computer Science 1 and Practical Computer Science 2 can be completed in the Bachelor of Science degree programme at the University of Tübingen as part of the supplementary modules 1-4.	

The following modules must be completed in the 2nd subject area. These are entire modules from the subject Computer Science in the Bachelor's or Master's of Education Lehramt Gymnasium degree programmes.

[¶]All information provided here refers to the study and examination regulations of the University of Tübingen for the degree programme Computer Science with academic final examination Bachelor of Science (B. Sc.) in the version of 25.03.2021 (Amtl.Bek.UT 10/2021, p. 293) or the study and examination regulations of the University of Tübingen for the degree programme Physics with academic final examination Bachelor of Science (B. Sc.) in the version dated 30 July 2013 (Amtl.Bek.UT 16/2013, p. 787); the responsible examination board decides on the recognition of other achievements.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Computer Science							
1-4	INFM2111	Practical Computer Science 3: Software Engeneering	L+E	PM	EC	Wr.	6
1-3	INFM2310	Computer Engeneering 2: Computer Science of Systems	L+E	PM	EC	Wr.	9
1-3	INFM2410	Theoretical Computer Science 2: Formal Languages, Computability and Complexity	L+E	PM	EC	Wr.	9
1-3	INFM2420	Theoretical Computer Science 1: Algorithms and Data Structures	L+E	PM	EC	Wr.	9
3-4	INFL20	Compulsory Elective Module I	L+E	PMW	EC	Wr. o. Or.	6
3-4	INFM3110	Elective subject Practical Computer Science	L+P	PMW		Wr. o. Or.	6*
3-4	INFM3310	Elective subject Computer Engeneering	L+P	PMW		Wr. o. Or.	6*
3-4	INFM3410	Elective subject Theoretical Computer Science	L+P	PMW		Wr. o. Or.	6*
						Sum	45 CP

*Only one of the compulsory elective modules Practical Computer Science, Computer Engineering and Theoretical Computer Science needs to be taken.

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.3.6 Degree B.Sc. Physics, seconnd Subject Mathematics

For the second subject Mathematics, the following prerequisites from the Bachelor of Science Physics degree programme at the University of Tübingen, which is the basis for admission to the degree programme, or comparable achievements from another degree programme that is the basis for admission to the degree programme are required.

Preliminary work for the second subject Mathematics[‖]	
Mathematics for Physicists 1 (MP1)	9 CP
Mathematics for Physicists 2 (MP2)	9 CP
Sum	18 CP

The following modules must be completed in the 2nd subject area. These are entire modules from the subject of physics in the Bachelor's and Master's of Education Lehramt Gymnasium degree programmes.

[‖]All information provided here refers to the study and examination regulations of the University of Tübingen for the degree programme Physics with academic final examination Bachelor of Science (B. Sc.) in the version of 30 July 2013 (Amtl.Bek.UT 16/2013, p. 787) or the study and examination regulations of the University of Tübingen for the degree programme Mathematics with academic final examination Bachelor of Science (B. Sc.) in the version dated 05.08.2019 (Amtl.Bek.UT 15/2019, p. 443); the relevant examination board decides on the recognition of other achievements.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 1: 2nd Subject Mathematics							
1-4	MAT-20-06	Compulsory Intermediate Modules Analysis		PM		Or.	13,5*
		- Measure and Integration Theory	L+E		EC		
		- Introduction to ODE	L+E		EC		
		- Introduction to Complex Analysis	L+E		EC		
1-4	MAT-20-06	Compulsory Intermediate Modules Algebra and Geometry		PM		Or.	13,5*
		- Algebraic Structures	L+E		ÜN		
		- Introduction to Galois Theory	L+E		EC		
		- Introduction to Geometry	L+E		EC		
1-4	MAT-20-12	Stochastik	L+E	PM	EC	Wr. o. Or.	9*
1-4	MAT-20-13	Numerical Mathematics**	L+E	PM	EC	Wr. o. Or.	6*
1-4	MAT-20-20	Introductory seminar	PS	PMW	s.M.	Pr	3
						Summe	45 CP

* If the competences of the module or of a submodule have already been acquired, to a large extent, in the Bachelor's programme that entitles the student to admission to this programme, the (sub)module must be replaced by another achievement in consultation with the Chair of the Examination Board. This must be clarified and determined as part of the admission process.

** The module Numerical Analysis may, upon application to the Chair of the Examination Board, be replaced by the module Mathematics for Computer Science 4: Numerical Analysis. The latter is offered in the summer semester, which makes the study plan more flexible.

Abbreviations:

Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.4 Programme Structure in Study Area Subject Didactics

In the following sections, the modules to be completed in the Subject Didactics programme area are listed in tabular form for the various subject combinations.

2.4.1 Combination of Computer Science and Mathematics

In the case of the subject combination Computer Science and Mathematics, the following modules must be completed in Subject Didactics.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 4: Subject Didactics (Computer Science – Mathematics)							
1-2	INFL01	Subject Didactics Computer Science I	S	PM	s.M.	Pr	3
2-3	INFL02	Subject Didactics Computer Science II	L+E	PM		TP+Pr	6
3-4	INFL03a	Subject Didactics Computer Science IIIa (MEd IPM)	S	PM	s.M.	-	3*
1-2	MAT-80-01	Subject Didactics Mathematics 1	SV	PM	s.M.	Wr. o. Or.	3
2-3	MAT-80-04	Subject Didactics Mathematics 2 (MEd-IPM)	SV	PM	s.M.	Wr. o. Or. o. Pr o. TP	3
3-4	MAT-80-05	Subject Didactics Mathematics 3: Professional Knowledge	S	PM	s.M.	Wr. o. Or. o. Pr o. TP	3
3-4	MAT-80-06	Subject Didactics Mathematics 3: Elective area	S	PMW	s.M.	Wr. o. Or. o. Pr o. TP	3*
						Sum	21 CP

*Only one of the modules Subject Didactics Computer Science IIIa and Subject Didactics Mathematics 3: Elective Area needs to be taken.

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.4.2 Combination of Computer Science and Physics

In the case of the subject combination Computer Science and Physics, the following modules must be completed in Subject Didactics.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 4: Subject Didactics (Computer Science – Physics)							
1-2	INFL01	Subject Didactics Computer Science I	S	PM	s.M.	Pr	3
2-3	INFL02	Subject Didactics Computer Science II	L+E	PM		TP+Pr	6
3-4	INFL03a	Subject Didactics Computer Science IIIa (MEd IPM)	S	PM	s.M.	-	3*
1-2	BLP05F	Subject Didactics Physics 1	S	PM	s.M.	Wr. o. Or.	3*
2-3	BLP06F	Subject Didactics Physics 2 (MEd-IPM)	S	PM	-	Wr. o. Or.	3*
2-3	BLP06S	Subject Didactics Physics 3 (MEd-IPM)	S	PM	-	Wr. o. Or.	3*
3-4	MLP10F	Subject Didactics Physics 4	SÜ	PM	s.M.	-	3*

3-4	MLP12F	Subject Didactics Physics 5	SÜ	PM	s.M.	Wr. o. Or.	3*
						Sum	21 CP

*Four of the modules Subject Didactics Physics 1, Subject Didactics Physics 2 (MEd-IPM), Subject Didactics Physics 3 (MEd-IPM), Subject Didactics Physics 4, Subject Didactics Physics 5 and Subject Didactics Computer Science IIIa must be taken. It is recommended to take the module Subject Didactics Physics 1.

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.4.3 Combination of Mathematics and Physics

In the case of the subject combination Mathematics and Physics, the following modules must be completed in the subject didactics area.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 4: Subject didactics (mathematics – physics)							
1-2	MAT-80-01	Subject Didactics Mathematics 1	SV	PM	s.M.	Wr. o. Or.	3
2-3	MAT-80-04	Subject Didactics Mathematics 2 (MEd-IPM)	SV	PM	s.M.	Wr. o. Or. o. Pr o. TP	3
3-4	MAT-80-05	Subject Didactics Mathematics 3: Professional Knowledge	S	PM	s.M.	Wr. o. Or. o. Pr o. TP	3
3-4	MAT-80-06	Subject Didactics Mathematics 3: Elective area	S	PMW	s.M.	Wr. o. Or. o. Pr o. TP	3*
1-2	BLP05F	Subject Didactics Physics 1	S	PM	s.M.	Wr. o. Or.	3*
2-3	BLP06F	Subject Didactics Physics 2 (MEd-IPM)	S	PM	-	Wr. o. Or.	3*
2-3	BLP06S	Subject Didactics Physics 3 (MEd-IPM)	S	PM	-	Wr. o. Or.	3*
3-4	MLP10F	Subject Didactics Physics 4	SÜ	PM	s.M.	-	3*
3-4	MLP12F	Subject Didactics Physics 5	SÜ	PM	s.M.	Wr. o. Or.	3*
						Sum	21 CP

*Four of the modules Subject Didactics Physics 1, Subject Didactics Physics 2 (MEd-IPM), Subject Didactics Physics 3 (MEd-IPM), Subject Didactics Physics 4, Subject Didactics Physics 5 and Subject Didactics Mathematics 3: Wahlbereich must be taken. It is recommended to take the module "Subject Didactics Physics 1".

Abbreviations:
Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.5 Programme Structure in Study Area Education Science

The modules to be completed in the Education Science programme area are listed in the following table. These are complete modules from the Education Science study area of the Bachelor's and Master's of Education Lehramt Gymnasium degree programmes or new modules that are made up of parts of such modules.

ST	Module Number	Module Title	Type of Course	Type of Module	Course-work	Type of Exam	ECTS-Points
Section 5: Education Science							
1-2	BWS-ME0	Education Science 1 (MEd-IPM)	L+S	PM	-	Wr. o. Or.	5
1-2	BWS-ME1	School Pedagogy I	S+S	PM	-	Wr. o. Or.	6
2-3	BWS-ME3	Inclusion, Diversity and Heterogeneity	L+L/S	PMW	-	Wr.	6
3-4	BWS-ME4	Empirical Educational Research and Educational Psychology	V	PM	-	Wr.	6
						Sum	23 CP

Abbreviations:

Type of Module : PM=compulsory module, PMW=compulsory module with choice, WPM=elective module
Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Course Work : EC=exercise certificate, PEC=practical exercise certificate, PC=practical certificate
Other : h=hours, o.=or, s.M.=see module description, ST=suggested term

2.6 Exemplary Study Plans

As expected, the study requirements of students on this degree programme are very heterogeneous and, depending on the subject combination, there is also a certain degree of freedom with regard to the choice of modules. For this reason, it is not possible to specify binding study pathways for the subject combinations. However, in order to show that the degree programmes can be studied and, if applicable, how they can be studied, we will provide exemplary study plans for each subject combination on the following pages, both for students starting in the winter semester and for students starting in the summer semester. Since many of the compulsory courses are only offered in the winter or summer semester and since the school practice semester blocks half a semester, it is not possible to achieve an even distribution of credit points with exactly 30 CP per semester. We therefore recommend that prospective students discuss a possible individual study plan with the Faculty Course Advisor of their chosen second subject in an academic counselling session if possible before starting their studies. However, this should be done at the latest upon commencement of the degree programme.

2.6.1 Degree B.Sc. Computer Science, second Subject Mathematics

<table>
<tr><th colspan="7">Degree B.Sc. Computer Science, second Subject Mathematics
Possible Study Plan for Students Starting in the Winter Semester – Modules</th></tr>
<tr><th>FS</th><th>CP</th><th colspan="5">Module Achievements</th></tr>
<tr><td>1</td><td>35</td><td rowspan="2">Compulsory Intermediate Modules Algebra and Geometry (9 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (9 CP)</td><td>Numerical Mathematics (6 CP)</td><td colspan="2">Inclusion, Diversity and Heterogeneity (6 CP)</td><td>Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>28</td><td>Introductory seminar (3 CP)</td><td>SD Math 1 (3 CP)
Subject Didactics Computer Science I (3 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td><td rowspan="2">School Pedagogy 1 (4+2=6 CP)</td></tr>
<tr><td>3</td><td>24</td><td colspan="3">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
<tr><td>4</td><td>33</td><td colspan="3">Master Thesis (15 CP)</td><td>Stochastik (9 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
<tr><td colspan="7">Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)</td></tr>
</table>

<table>
<tr><th colspan="4">Degree B.Sc. Computer Science, second Subject Mathematics
Possible Study Plan for Students Starting in the Winter Semester – Submodules</th></tr>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">35</td><td>Introduction to Numerical Mathematics (4,5 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td>Mathematical Software (1,5 CP)</td><td>Education Science 1 (5 CP)</td></tr>
<tr><td>Algebraic Structures (4,5 CP)</td><td>Measure and Integration Theory(4,5 CP)</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">28</td><td>Introduction to Geometry (4,5 CP)</td><td>Introduction to ODE (4,5 CP)</td></tr>
<tr><td>Galois Theory (4,5 CP)</td><td>Introduction to Complex Analysis (4,5 CP)</td></tr>
<tr><td>Introductory seminar (3 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">24</td><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td></td><td rowspan="2">School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)
School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td>School Practise Semester (16 CP)</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">33</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
<tr><td>Stochastics (9 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td></tr>
<tr><td colspan="2">Subject Didactics Computer Science II (6 CP)</td><td>Master Thesis (15 CP)</td></tr>
<tr><td colspan="4">Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)</td></tr>
</table>

Degree B.Sc. Computer Science, second Subject Mathematics

Alternative possible Study Plan for Students Starting in the Winter Semester – Modules

<table>
<tr><th>FS</th><th>CP</th><th colspan="5">Module Achievements</th></tr>
<tr><td>1</td><td>32</td><td rowspan="2">Compulsory Intermediate Modules Algebra and Geometry (13,5 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (13,5 CP)</td><td>Introductory seminar (3 CP)</td><td colspan="2">Inclusion, Diversity and Heterogeneity (6 CP)</td><td>Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>31</td><td rowspan="2">Mathematics für Computer Science 4: Numerical Mathematics (6 CP)</td><td>SD Math 1 (3 CP)</td><td rowspan="2">Empirical Educational Research and Educational Psychology (6 CP)</td><td rowspan="3">School Pedagogy 1 (4+2=6 CP)</td></tr>
<tr><td>3</td><td>24</td><td colspan="2">School Practise Semester (16 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td>3</td><td>24</td><td colspan="2">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
<tr><td>4</td><td>33</td><td colspan="2">Master Thesis (15 CP)</td><td>Stochastics (9 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Mathematics

Alternative possible Study Plan for Students Starting in the Winter Semester – Submodules

<table>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td rowspan="5">1</td><td rowspan="5">32</td><td>Introductory seminar (3 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td></td><td>Education Science 1 (5 CP)</td></tr>
<tr><td>Algebraic Structures (4,5 CP)</td><td>Measure and Integration Theory(4,5 CP)</td></tr>
<tr><td rowspan="2">Introduction to Geometry (4,5 CP)</td><td rowspan="2">Introduction to ODE (4,5 CP)</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">31</td></tr>
<tr><td>Galois Theory (4,5 CP)</td><td>Introduction to Complex Analysis (4,5 CP)</td></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td>Mathematics für Computer Science 4: Numerical Mathematics (6 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td></td><td rowspan="2">School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)
School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">24</td><td rowspan="2">School Practise Semester (16 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">33</td><td>Stochastics (9 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td></tr>
<tr><td>Subject Didactics Computer Science II (6 CP)</td><td>Master Thesis (15 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Mathematics

Possible Study Plan for Students Starting in the Summer Semester – Modules

<table>
<tr><th>FS</th><th>CP</th><th colspan="6">Module Achievements</th></tr>
<tr><td>1</td><td>29</td><td rowspan="2">Intermediate Modules Algebra and Geometry Compulsory (13,5 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (13,5 CP)</td><td>Introductory seminar (3 CP)</td><td>SD Math 1 (3 CP)
Subject Didactics Computer Science I (3 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td><td>Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>32,5</td><td>Numerical Mathematics (6 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td><td>School Pedagogy 1 (2+4=6 CP)</td></tr>
<tr><td>3</td><td>34,5</td><td>Stochastics (9 CP)</td><td colspan="2">Master Thesis (15 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
<tr><td>4</td><td>24</td><td colspan="2">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td><td>School Pedagogy 1 (2+4=6 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Mathematics

Possible Study Plan for Students Starting in the Winter Semester – Submodules

<table>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td>1</td><td>29</td><td>Introductory seminar (3 CP)</td><td>Education Science 1 (5 CP)</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td></td><td>Empirical Educational Research and Educational Psychology (6 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td rowspan="4">Algebraic Structures (4,5 CP)
Introduction to Geometry (4,5 CP)</td><td rowspan="4">Introduction to Complex Analysis (4,5 CP)
Measure and Integration Theory(4,5 CP)
Introduction to ODE (4,5 CP)</td></tr>
<tr><td>2</td><td>32,5</td></tr>
<tr><td rowspan="2">Introduction to Numerical Mathematics (4,5 CP)
Mathematical Software (1,5 CP)</td></tr>
<tr><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)</td></tr>
<tr><td>3</td><td>34,5</td><td>Galois Theory (4,5 CP)</td><td>Master Thesis (15 CP)</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Stochastics (9 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
<tr><td>4</td><td>24</td><td>School Practise Semester (16 CP)</td><td>School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td></td><td></td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Mathematics

Alternative possible Study Plan for Students Starting in the Summer Semester – Modules

<table>
<tr><th>FS</th><th>CP</th><th colspan="6">Module Achievements</th></tr>
<tr><td>1</td><td>32</td><td rowspan="3">Intermediate Modules Algebra and Geometry Compulsory (13,5 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (13,5 CP)</td><td>Mathematics für Computer Science 4: Numerical Mathematics (6 CP)</td><td>SD Math 1 (3 CP)
Subject Didactics Computer Science I (3 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td><td>Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>29,5</td><td>Introductory seminar (3 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td><td>School Pedagogy 1 (2+4=6 CP)</td></tr>
<tr><td>3</td><td>34,5</td><td>Stochastics (9 CP)</td><td colspan="2">Master Thesis (15 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
<tr><td>4</td><td>24</td><td colspan="3">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td><td>School Pedagogy 1 (2+4=6 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Mathematics

Alternative possible Study Plan for Students Starting in the Winter Semester – Submodules

<table>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td>1</td><td>32</td><td>Introduction to Numerical Mathematics (4,5 CP)</td><td>Education Science 1 (5 CP)</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td>Mathematical Software (1,5 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td rowspan="4">Algebraic Structures (4,5 CP)
Introduction to Geometry (4,5 CP)
Introductory seminar (3 CP)</td><td rowspan="4">Introduction to Complex Analysis (4,5 CP)
Measure and Integration Theory(4,5 CP)
Introduction to ODE (4,5 CP)</td></tr>
<tr><td>2</td><td>29,5</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td></td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)</td></tr>
<tr><td>3</td><td>34,5</td><td>Galois Theory (4,5 CP)</td><td>Master Thesis (15 CP)</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Stochastics (9 CP)</td><td>Subject Didactics Computer Science II (6 CP)</td></tr>
<tr><td>4</td><td>24</td><td>School Practise Semester (16 CP)</td><td>School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td></td><td></td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

2.6.2 Degree B.Sc. Computer Science, second Subject Physics

Degree B.Sc. Computer Science, second Subject Physics

Possible Study Plan for Students Starting in the Winter Semester

FS	CP	Module Achievements					
1	35	Physics BC Optics + Advanced Study (9 CP)		Physics BC Analytical Mechanics (6 CP)	Modern Physics A (12 CP)	Subject Didactics Physics 1 (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	28	Physics Laboratory A (6 CP)	Physics Laboratory B + Demonstration Laboratory (6 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Subject Didactics Computer Science I (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	School Pedagogy 1 (4+2=6 CP)
3	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	
4	30	Master Thesis (15 CP)		Modern Physics D (6 CP)		Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Physics

Possible Study Plan for Students Starting in the Summer Semester

FS	CP	Module Achievements					
1	32	Modern Physics D (9 CP)	Physics Laboratory A (6 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Subject Didactics Computer Science I (3 CP)	Education Science 1 (MEd-IPM) (5 CP)	Inclusion, Diversity and Heterogeneity (6 CP)
2	33	Physics BC Optics and Advanced Study (9 CP)	Physics BC Analytical Mechanics (6 CP)	Modern Physics A (12 CP)		Subject Didactics Physics 1 (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)
3	31	Master thesis (15 CP)			Physics Laboratory B + Demonstration Laboratory (6 CP)	Subject Didactics Computer Science II (6 CP)	Pedagogy 1
4	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	School (4+2=6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

2.6.3 Degree B.Sc. Mathematics, second Subject Computer Science

Degree B.Sc. Mathematics, second Subject Computer Science

Possible Study Plan for Students Starting in the Winter Semester

FS	CP	Module Achievements					
1	29	Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)		Practical Computer Science 3: Software Engeneering (6 CP)	Compulsory Elective Module I (6 CP)	Subject Didactics Mathematics 2: Geometry (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	34	Theoretical Computer Science 2: Formal Languages, Computability and Complexity (9 CP)	Subject Didactics Computer Science I (3 CP)	Subject Didactics Mathematics 1 (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Inclusion, Diversity and Heterogeneity (6 CP)	School Pedagogy 1 (4+2=6 CP)
3	24	School Practise Semester (16 CP)			Subject Didactics Mathematics 3: Professional Knowledge (3 CP)	Subject Didactics Computer Science IIIa (3 CP)	
4	33	Master thesis (15 CP)			Computer Engeneering 2: Computer Science of Systems (9 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)	Subject Didactics Computer Science II (6 CP)

Degree B.Sc. Mathematics, second Subject Computer Science

Possible Study Plan for Students Starting in the Summer Semester

FS	CP	Module Achievements					
1	29	Theoretical Computer Science 2: Formal Languages, Computability and Complexity (9 CP)		Subject Didactics Computer Science I (3 CP)	Subject Didactics Mathematics 1 (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Mathematics 3: Professional Knowledge (3 CP)	
3	31	Computer Engeneering 2: Computer Science of Systems (9 CP)	Compulsory Elective Module I (6 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)	Subject Didactics Mathematics 2: Algebra (3 CP)	Subject Didactics Computer Science II (6 CP)	School Pedagogy 1 (2+4=6 CP)
4	36	Master thesis (15 CP)			Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)	Practical Computer Science 3: Software Engeneering (6 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

2.6.4 Degree B.Sc. Mathematics, second Subject Physics

Degree B.Sc. Computer Science, second Subject Physics

Possible Study Plan for Students Starting in the Winter Semester

FS	CP	Module Achievements					
1	35	Physics BC Optics + Advanced Study (9 CP)		Physics BC Analytical Mechanics (6 CP)	Modern Physics A (12 CP)	Subject Didactics Physics 1 (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	31	Physics Laboratory A (6 CP)	Physics Laboratory B + Demonstration Laboratory (6 CP)	Subject Didactics Physics 2+3 (6 CP)	Subject Didactics Mathematics 1 (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	School Pedagogy 1 (4+2=6 CP)
3	24	School Practise Semester (16 CP)			Subject Didactics Mathematics 3 (3 CP)	Subject Didactics Physics 4 (3 CP)	
4	30	Master Thesis (15 CP)		Modern Physics D (6 CP)		Subject Didactics Mathematics 2 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Computer Science, second Subject Physics

Possible Study Plan for Students Starting in the Winter Semester – Alternative

FS	CP	Module Achievements					
1	32	Physics BC Optics + Advanced Study (9 CP)	Physics BC Analytical Mechanics (6 CP)	Physics Laboratory A (6 CP)	Modern Physics A - Part: Molecule, Atom, Light (3 CP)	Subject Didactics Physics 1 (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	34	Basic Module Quantum Mechanics (9 CP)	Physics Laboratory B + Demonstration Laboratory (6 CP)	Subject Didactics Physics 2+3 (6 CP)	Subject Didactics Mathematics 1 (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	School Pedagogy 1 (4+2=6 CP)
3	24	School Practise Semester (16 CP)			Subject Didactics Mathematics 3 (3 CP)	Subject Didactics Physics 4 (3 CP)	
4	30	Master Thesis (15 CP)		Modern Physics D (6 CP)		Subject Didactics Mathematics 2 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Notes:
*The Modern Physics A module can also be replaced, in consultation with the Faculty Course Advisor, by successful participation in the Basic Module Quantum Mechanics from the B.Sc. Physics together with the section "Molecules, Atom, Light" from the module Modern Physics A.

Degree B.Sc. Computer Science, second Subject Physics

Possible Study Plan for Students Starting in the Summer Semester

FS	CP	Module Achievements					
1	29	Modern Physics D (9 CP)	Physics Laboratory A (6 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Subject Didactics Mathematics 1 (3 CP)	Subject Didactics Mathematics 2 (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	36	Physics BC Optics and Advanced Study (9 CP)	Physics BC Analytical Mechanics (6 CP)	Modern Physics A (12 CP)		Subject Didactics Physics 1 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)
3	31	Master thesis (15 CP)			Physics Laboratory B + Demonstration Laboratory (6 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Pedagogy 1 School (4+2=6 CP)
4	24	School Practise Semester (16 CP)			Subject Didactics Mathematics 3 (3 CP)	Subject Didactics Physics 4 (3 CP)	

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Mathematics, second Subject Physics

Possible Study Plan for Students Starting in the Summer Semester - Alternative

FS	CP	Module Achievements					
1	29	Modern Physics D (6 CP)	Physics Laboratory A (6 CP)	Subject Didactics Physics 2 + 3 (MEd-IPM) (3+3 CP)	Subject Didactics Mathematics 1 (3 CP)	Subject Didactics Mathematics 2: Algebra (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	24	School Practise Semester (16 CP)			Subject Didactics Physics 4 (3 CP)	Subject Didactics Mathematics 3: Professional Knowledge (3 CP)	School Pedagogy 1 (2+4=6 CP)
3	31	Master thesis* (15 CP)			Physics Laboratory B + Demonstration Laboratory (6 CP)	Empirical Educational Research and Educational Psychology (6 CP)	
4	36	Physics BC Optics and Advanced Study (9 CP)	Physics BC Analytical Mechanics (6 CP)	Modern Physics A (12 CP)		Subject Didactics Physics 1 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Notes:
*In this case, the Master's thesis cannot be written in Physics but must be written in the subject Mathematics.

2.6.5 Degree B.Sc. Physics, second Subject Computer Science

Degree B.Sc. Physics, second Subject Computer Science

Possible Study Plan for Students Starting in the Winter Semester

FS	CP	Module Achievements					
1	29	Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)		Practical Computer Science 3: Software Engeneering (6 CP)	Compulsory Elective Module I (6 CP)	Subject Didactics Physics 1 (3 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	34	Theoretical Computer Science 2: Formal Languages, Computability and Complexity (9 CP)	Subject Didactics Computer Science I (3 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Inclusion, Diversity and Heterogeneity (6 CP)	School Pedagogy 1 (4+2=6 CP)
3	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	
4	33	Master thesis (15 CP)			Computer Engeneering 2: Computer Science of Systems (9 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)	Subject Didactics Computer Science II (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Physics, second Subject Computer Science

Possible Study Plan for Students Starting in the Summer Semester

FS	CP	Module Achievements					
1	32	Theoretical Computer Science Formal Languages, Computability and ((9 CP)		Subject Didactics Computer Science I (3 CP)	Subject Didactics Physics 2 + 3 (MEd-IPM) (3+3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	Pedagogy 1 School (2+4=6 CP)
3	28	Computer Engeneering 2: Computer Science of Systems (9 CP)	Compulsory Elective Module I (6 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)		Subject Didactics Computer Science II (6 CP)	
4	36	Master thesis (15 CP)			Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)	Practical Computer Science 3: Software Engeneering (6 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Physics, second Subject Computer Science

Possible Study Plan for Students Starting in the Summer Semester - Alternative 1

FS	CP	Module Achievements					
1	29	Theoretical Computer Science Formal Languages, Computability and (9 CP)		Subject Didactics Computer Science I (3 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	School Pedagogy 1 (2+4=6 CP)
3	31	Master thesis* (15 CP)			Computer Engeneering 2: Computer Science of Systems (9 CP)	Subject Didactics Computer Science II (6 CP)	
4	36	Compulsory Elective Module I (6 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)	Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)	Practical Computer Science 3: Software Engeneering (6 CP)	Subject Didactics Physics 1 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Notes:
*In this case, the Master's thesis cannot be written in Computer Science but must be written in the subject Physics.

Degree B.Sc. Physics, second Subject Computer Science

Possible Study Plan for Students Starting in the Summer Semester - Alternative 2

FS	CP	Module Achievements					
1	29	Theoretical Computer Science Formal Languages, Computability and (9 CP)		Subject Didactics Computer Science I (3 CP)	Subject Didactics Physics 2 (MEd-IPM) (3 CP)	Empirical Educational Research and Educational Psychology (6 CP)	Education Science 1 (MEd-IPM) (5 CP)
2	36	Compulsory Elective Module I (6 CP)	Elective subject Theoretical or Practical Computer Science or Computer Engineering (6 CP)	Theoretical Computer Science 1: Algorithms and Data Structures (9 CP)	Practical Computer Science 3: Software Engeneering (6 CP)	Subject Didactics Physics 1 (3 CP)	Inclusion, Diversity and Heterogeneity (6 CP)
3	31	Master thesis (15 CP)			Computer Engeneering 2: Computer Science of Systems (9 CP)	Subject Didactics Computer Science II (6 CP)	
4	24	School Practise Semester (16 CP)			Subject Didactics Computer Science IIIa (3 CP)	Subject Didactics Physics 4 (3 CP)	School Pedagogy 1 (4+2=6 CP)

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

2.6.6 Degree B.Sc. Physics, second Subject Mathematics

Degree B.Sc. Physics, second Subject Mathematics

Possible Study Plan for Students Starting in the Winter Semester – Modules

<table>
<tr><th>FS</th><th>CP</th><th colspan="6">Module Achievements</th></tr>
<tr><td>1</td><td>32</td><td rowspan="2">Compulsory Intermediate Modules Algebra and Geometry (9 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (9 CP)</td><td>Numerical Mathematics (6 CP)</td><td colspan="2">Subject Didactics Physics 1 (3 CP)</td><td>Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>31</td><td>SD Math 1 (3 LP)
Subject Didactics Mathematics 2 (3 LP)</td><td>Subject Didactics Physics 2 (6 CP)</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td><td rowspan="2">School Pedagogy 1 (4+2=6 CP)</td></tr>
<tr><td>3</td><td>24</td><td colspan="3">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Physics 4 (3 CP)</td></tr>
<tr><td>4</td><td>33</td><td colspan="3">Master Thesis (15 CP)</td><td>Stochastics (9 CP)</td><td>Introductory seminar (3 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Physics, second Subject Mathematics

Possible Study Plan for Students Starting in the Winter Semester – Submodules

<table>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">32</td><td>Introduction to Numerical Mathematics (4,5 CP)</td><td>Subject Didactics Physics 1 (3 CP)</td></tr>
<tr><td>Mathematical Software (1,5 CP)</td><td>Education Science 1 (5 CP)</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">31</td><td>Algebraic Structures (4,5 CP)</td><td>Measure and Integration Theory(4,5 CP)</td></tr>
<tr><td>Introduction to Geometry (4,5 CP)</td><td>Introduction to ODE (4,5 CP)</td></tr>
<tr><td>Galois Theory (4,5 CP)</td><td>Introduction to Complex Analysis (4,5 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Computer Science I (3 CP)</td></tr>
<tr><td>Subject Didactics Mathematics 2 (3 LP)</td><td></td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">24</td><td>Empirical Educational Research and Educational Psychology (6 CP)</td><td>School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)</td></tr>
<tr><td>School Practise Semester (16 CP)</td><td>School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">33</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Computer Science IIIa (3 CP)</td></tr>
<tr><td>Stochastics (9 CP)</td><td>Introductory seminar (3 CP)</td></tr>
<tr><td></td><td></td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td><td>Master Thesis (15 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Physics, second Subject Mathematics

Possible Study Plan for Students Starting in the Summer Semester – Modules

<table>
<tr><th>FS</th><th>CP</th><th colspan="6">Module Achievements</th></tr>
<tr><td>1</td><td>32</td><td rowspan="3">Intermediate Modules Algebra and Geometry Compulsory (13,5 CP)</td><td rowspan="2">Compulsory Intermediate Modules Analysis (13,5 CP)</td><td rowspan="2">Introductory seminar (3 CP)</td><td>SD Math 1 (3 CP)</td><td rowspan="2">Empirical Educational Research and Educational Psychology (6 CP)</td><td rowspan="2">Education Science 1 (MEd-IPM) (5 CP)</td></tr>
<tr><td>2</td><td>31,5</td><td>FD Physics 2 (6 CP)</td></tr>
<tr><td>2</td><td>31,5</td><td rowspan="2">Numerical Mathematics (6 CP)</td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Subject Didactics Physics 1 (3 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td>3</td><td>32,5</td><td>Stochastics (9 CP)</td><td colspan="2">Master Thesis (15 CP)</td><td rowspan="2">School Pedagogy 1 (2+4=6 CP)</td></tr>
<tr><td>4</td><td>24</td><td colspan="3">School Practise Semester (16 CP)</td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Physics 4 (3 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

Degree B.Sc. Physics, second Subject Mathematics

Possible Study Plan for Students Starting in the Winter Semester – Submodules

<table>
<tr><th>FS</th><th>CP</th><th colspan="2">List of Submodules</th></tr>
<tr><td>1</td><td>29</td><td>Introductory seminar (3 CP)</td><td>Education Science 1 (5 CP)</td></tr>
<tr><td></td><td></td><td></td><td>Empirical Educational Research and Educational Psychology (6 CP)</td></tr>
<tr><td></td><td></td><td>Subject Didactics Mathematics 1 (3 CP)</td><td>Subject Didactics Physics 2 (6 CP)</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">34,5</td><td>Algebraic Structures (4,5 CP)</td><td>Introduction to Complex Analysis (4,5 CP)</td></tr>
<tr><td>Introduction to Geometry (4,5 CP)</td><td>Measure and Integration Theory(4,5 CP)</td></tr>
<tr><td>Introduction to Numerical Mathematics (4,5 CP)</td><td>Introduction to ODE (4,5 CP)</td></tr>
<tr><td>Mathematical Software (1,5 CP)</td><td>Inclusion, Diversity and Heterogeneity (6 CP)</td></tr>
<tr><td></td><td></td><td>Subject Didactics Mathematics 2 (3 CP)</td><td>Subject Didactics Physics 1 (3 CP)</td></tr>
<tr><td>3</td><td>32,5</td><td>Galois Theory (4,5 CP)</td><td>Master Thesis (15 CP)</td></tr>
<tr><td></td><td></td><td>Stochastics (9 CP)</td><td>School Pedagogy 1 – Micro level: Teaching in theory and research (4 CP)</td></tr>
<tr><td>4</td><td>24</td><td>School Practise Semester (16 CP)</td><td>School Pedagogy 1 – School practice in theory and research (2 CP)</td></tr>
<tr><td></td><td></td><td>Subject Didactics Mathematics 3: Professional Skills (3 CP)</td><td>Subject Didactics Physics 4 (3 CP)</td></tr>
</table>

Explanation of the Abbreviations: FS=semester, CP=credit points (ECTS points)

3 Module Descriptions

Section 1: 2nd Subject Computer Science

Module Number: **INFL20**	**Module Title:** Elective Module I		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload **- Time in Class** **- Self-Study**	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, excercise class		
Comment	Instead of a lecture with exercise classes, a lecture without exercise classes totalling 4 SWS can also be included.		
Content	The module imparts advanced knowledge of computer science. These are acquired in selected courses from the compulsory elective subjects Practical Computer Science, Computer Engineering, Theoretical Computer Science, as well as other compulsory elective subjects in Bioinformatics and Medical Informatics. Students can also take courses from the corresponding compulsory elective subjects of the Master's degree programmes in Computer Science (compulsory elective subject Practical Computer Science, Computer Engineering, Theoretical Computer Science), Bioinformatics or Medical Informatics.		
Objectives	Students are familiar with current issues and fields of research in computer science, have in-depth theoretical, practical and technical knowledge in relation to selected topics, have different analytical and methodological approaches to computer science, had the opportunity to improve their communication skills and their ability to work in small groups.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Selected course	L	o	3	4,5	-	wr. o. or.	60	g	100
	P	o	1	1,5					

Transfer	-

Prerequisites	There ae no prerequisites.
Responsible Persons	Professors from the Computer Science Department

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM2111	**Module Title:** Practical Computer Science 3: Software Engineering		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	1-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, excercise class		
Content	The module covers the topics of introduction to software engineering, Software project management, software process models, requirements management, large-scale programming, API and library design, distributed and concurrent software systems software systems, module concept, version control, software quality (in particular test processes and software metrics as well as programme analyses), design by contract, design patterns, code reviews, SCRUM.		
Objectives	Competences: Students can name the essential areas of software engineering and categorise them in the context of a software development project; they can use established software development tools in a targeted manner; they are able to carry out basic quality assurance such as automated tests; they can design and implement software systems using basic object-oriented and functional design patterns.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Practical Computer Science 3: Software Engineering	L	o	2	4	yes	wr.	-	g	100
	E	o	2	2					

Transfer	-
Prerequisites	Knowledge of the Practical Computer Science 1 and Practical Computer Science 2 modules is required.
Responsible Persons	Klaus Ostermann

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM2310	**Module Title:** Computer Engineering 2: Computer Science of Systems		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	1-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, excercise class		
Content	The basic lecture provides an overview of the following five areas: Internet, coding, assembler programming, computer architecture, operating systems and power supply. In all 5 areas a basic system view is conveyed. The content of the 5 areas covers the following topics are covered: • Internet: Number representations and character encoding; protocol layers and basic structure of the Internet; • Coding: source coding, channel coding, line coding; • Assembler programming: basics, calling subroutines in assembler, use of the stack assembler, use of the stack, programme translation and execution, (effect of) compiler optimisation; • Computer architecture: Instruction set architecture, application binary interface, structure of computers, Moore's Law, basic performance considerations; Von Neumann architecture, CISC/RISC architectures; • operating systems: Structure of the processor, pipelining, hazards, exceptions; Memory technologies and hierarchy, locality principles, caches, processes and process management, structure and functionality of virtual memory, Translation-Lookaside Buffer (TLB), cache cohesion with multiple processors, user/kernel mode processors, user/kernel mode; structure of storage media, reliability, RAID; virtual machines, advantages of virtualisation, virtualisation methods, Virtual LAN (VLAN); I/O devices, handshaking protocols for buses, parallel and serial buses, PCI and serial buses, PCI, USB, control of I/O devices by the processor processor, data exchange between I/O devices and main memory, Direct Memory Access (DMA), further topics in the area of operating systems; • Energy supply: electricity grids, energy markets, electricity mix, combined heat and power, demand-side management, quantitative comparison of CO of CO 2 emissions, climate change and energy transition.		
Objectives	Students know the basics of the internet, coding, assembler programming, computer architecture, operating systems and energy supply. They are able to explain important terms, correlations, advantages and disadvantages. They understand the basic structure and functionality of the systems covered at various levels. Students are able to outline and interpret their structures and functions. They are able to recognise the theoretical concepts in practice and apply what they have learned.		

Requirements for obtaining Credits / Grading (Weighting if applicable)	Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
	Computer Engineering 2: Computer Science of Systems	L	o	4	6	yes	wr.	60	g	100
		E	o	2	3					
Transfer	-									
Prerequisites	There are no prerequisites									
Responsible Persons	Michael Menth									

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM2410	**Module Title:** Theoretical Computer Science 2: Formal Languages, Computability, and Complexity		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	1-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise class		
Content	Topics include formal languages, Chomsky grammars and automata, computability, decidability and recursive decidability, existence of undecidable problems, Rice's first theorem, complexity theory, time and space requirements and space requirements and NP-completeness.		
Objectives	Students have the ability to carry out standard constructions from the area of finite automata and regular expressions. They have an understanding of the phenomenon of non-computability and the frequency of its occurrence as well as a basic understanding of the concept of NP-completeness and its motivation.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Theoretical Computer Science 2: Formal Languages, Computability and Complexity	L	o	4	6	yes	wr.	90	g	100
	E	o	2	3					

Transfer	-
Prerequisites	There are no prerequisites
Responsible Persons	Ulrike von Luxburg, Philipp Hennig

Abbreviations:

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Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM2420	**Module Title:** Theoretical Computer Science 1: Algorithms and Data Structures		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	1-3		
Language of Instruction	German		
Forms of Teaching and Learning	lecture, excercise class		
Content	Introduction: computational models, efficiency measures; sorting methods: yuicksort, heapsort, mergesort; elementary data structures: lists, trees, graphs, dynamic search structures, hashing; graph algorithms: patterning, shortest paths, spanning trees; algorithms on strings: pattern search; programming: learnt algorithms and data structures.		
Objectives	Students have a basic knowledge of fundamental data structures in computer science and of algorithms for fundamental problems. Within this framework, they are familiar with the independent creative development of algorithms and data structures. Students know the interactions between data structures and algorithms and can apply these to concrete examples. Based on the analysis techniques they have learnt, they can evaluate simple algorithmic approaches according to their quality, efficiency and complexity. In addition, students are able to apply the implement the algorithms and data structures they have learnt.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Theoretical Computer Science 1: Algorithms and Data Structures	L	o	4	6	yes	wr.	90	g	100
	E	o	2	3					

Transfer	-
Prerequisites	Knowledge from the Practical Computer Science 1 module and basic knowledge of mathematics are required.
Responsible Persons	Michael Kaufmann

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM3110	**Module Title:** Elective Subject in Practical Computer Science		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, excercise class		
Comment	Instead of a lecture with exercise classes, a lecture without exercise classes totalling 4 SWS can also be included.		
Content	The module imparts basic knowledge of practical computer science. This knowledge is acquired in selected courses from the subject areas of practical computer science. These areas include, for example, image communication, database systems, graphical data processing, machine learning and artificial intelligence, human-computer interaction, web development and multimedia, programming languages and compiler construction, software engineering and cognitive modelling.		
Objectives	Students know the foundations of practical computer science and are able to apply these in a suitable context. They are able to communicate in an understandable way about the technical content of this area of computer science. They can model simple problems in an appropriate way and solve them.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Selected course	L	o	3	4,5	-	wr. o. or.	60	g	100
	P	o	1	1,5					

Transfer	-
Prerequisites	There are no prerequisites
Responsible Persons	Torsten Grust

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM3310	**Module Title:** Elective Subject in Computer Engineering		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise class		
Comment	Instead of a lecture with exercise classes, a lecture without exercise classes totalling 4 SWS can also be included.		
Content	The module imparts basic knowledge of computer engineering. These are acquired in selected courses from the subject areas of computer engineering. These areas include, for example, chip design, media technology, communication networks, computer architecture, robotics and other special chapters of computer engineering.		
Objectives	Students know the basics of computer engineering and are able to apply these in a suitable context. They are able to communicate in an understandable way about the technical content of this area of computer science. They can model simple problems in a suitable way and solve them.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Selected course	L	o	3	4,5	-	wr. o. or.	60	g	100
	P	o	1	1,5					

Transfer	-
Prerequisites	There are no prerequisites
Responsible Persons	Michael Menth

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM3410	**Module Title:** Elective Subject in Theoretical Computer Science		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise class		
Comment	Instead of a lecture with exercise classes, a lecture without exercise classes totalling 4 SWS can also be included.		
Content	The module imparts basic knowledge of theoretical computer science. These are acquired in selected courses from the subject areas of Theoretical Computer Science. These areas include, for example, algorithmics, computability and complexity, discrete mathematics, formal languages, cryptology and information theory and logic.		
Objectives	Students know the basics of theoretical computer science and are able to apply these in a suitable context. They are able to communicate in an understandable way about the technical content of this area of computer science. They can model simple problems in a suitable way and solve them.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Selected course	L	o	3	4,5	-	wr. o. or.	60	g	100
	P	o	1	1,5					

Transfer	-
Prerequisites	The module Theoretical Computer Science is a prerequisite.
Responsible Persons	Klaus-Jörn Lange

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 2: 2nd Subject Mathematics

Module Number: MAT-20-05	**Module Title:** Compulsory Intermediate Modules Analysis		**Type of Module:** Compulsory Module
ECTS-Points	13.5		
Workload - **Time in Class** - **Self-Study**	Workload: 405 h	Time in Class: 135 h	Self-Study: 270 h
Duration	2 Semester		
Frequency	• Measure and Integration Theory, regularly in Winter Semester • Introduction to ODE, regularly in Winter Semester • Introduction to Complex Analysis, regularly in Summer Semester		
Term	1-4		
Language of Instruction	German		
Forms of Teaching and Learning	• Measure and Integration Theory, Lecture 2 SWS + Ex.cl. 1 SWS • Introduction to ODE, Lecture 2 SWS + Ex.cl. 1 SWS • Introduction to Complex Analysis, Lecture 2 SWS + Ex.cl. 1 SWS		
Content	• Measure and Integration Theory: – Measures, in particular the Lebesgue measure. – Lebesgue integral, L^p-spaces, Fubini's theorem, convergence theorems. – Integration on areas of $\mathbb{R}^n$, transformation formula. – Convergence theorems. • Ordinary differential equations, a choice of the following: – Picard-Lindelöf existence and uniqueness theorem. – Linear ordinary differential equations, Gronwall's lemma. – Continous and differential dependence on initial conditions. – Basics of dynamical systems, stability of equilibrium positions. – Ordinary differential equations over the complex numbers. • Complex Analysis: – Holomorphic functions, Cauchy-Riemann equations. – Antiderivatives, Cauchy's integral formula, Cauchy's integral theorem. – Compact convergence of families of functions, power series, identity theorem. – Liouville's theorem, inverse function theorem for holomorphic functions, open mapping theorem, maximum principle. – Laurent series. – Residue theorem and applications.		

Objectives

Students are familiar with the fundamental concepts, constructions, results, and methods of proof in integration theory in several real variables and in general measure spaces. They have a sound knowledge of the foundations of complex analysis and the theory of ordinary differential equations. They master the essential computational techniques and are able to compute path integrals and to solve simple differential equations explicitly. In addition, they are capable of calculating areas and volumes, including those of more complex bodies, as well as multidimensional integrals. Students are acquainted with important applications of the theory, such as the fundamental theorem of algebra, Newton's fundamental equations of mechanics, and applications in probability theory. They have also acquired the ability to translate abstract questions into concrete problems in integration theory, complex analysis, or the theory of ordinary differential equations, and to solve them in these contexts.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students was trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Measure and Integration Theory	L	o	2	3	yes	or.	20-30	g	100
	E	o	1	1,5					
Introduction to ODE	L	o	2	3	yes				
	E	o	1	1,5					
Introduction to Complex Analysis	L	o	2	3	yes				
	E	o	1	1,5					

In each of the three submodules, an exercise certificate is required as course work. The assessment of the module takes the form of an oral examination covering all submodules. Admission to the oral examination requires at least two of the three exercise certificates. The module is deemed completed only once all three exercise certificates have been obtained and the oral examination has been passed.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature	**Possible References :** • Heinz Bauer: Wahrscheinlichkeitstheorie und Grundzüge der Maßtheorie. De Gruyter 1978. • Anton Deitmar: Analysis. Springer Spektrum 2017. • Jürgen Elstrodt: Maß- und Integrationstheorie. Springer 2011. • Otto Forster: Analysis 3. Friedr. Vieweg+Teubner 2011. • Lars Valerian Ahlfors: Complex analysis. McGraw-Hill 1979. • John B. Conway: Functions of one complex variable. Springer 1996. • Wolfgang Fischer, Ingo Lieb: Einführung in die Komplexe Analysis. Springer 2010. • Walter Rudin: Reelle und komplexe Analysis. Oldenbourg 2009. • Earl A. Coddington, Norman Levinson: Theory of ordinary differential equations. McGraw-Hill 1955. • William T. Reid: Ordinary differential equations. John Wiley & Sons 1971. • Hille, Einar: Ordinary differential equations in the complex domain. Dover Publications 1997. • Wasow, Wolfgang: Asymptotic expansions for ordinary differential equations. John Wiley 1965.
Transfer	-
Prerequisites	There are no further prerequisites.
Responsible Persons	Anton Deitmar, Peter Pickl, Reiner Schätzle, Stefan Teufel

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-20-06	**Module Title:** Compulsory Intermediate Modules Algebra and Geometry		**Type of Module:** Compulsory Module
ECTS-Points	13.5		
Workload - **Time in Class** - **Self-Study**	Workload: 405 h	Time in Class: 135 h	Self-Study: 270 h
Duration	2 Semester		
Frequency	• Algebraic Structures, regularly every Semester • Introduction to Galois Theory, regularly in Summer Semester • Introduction to Geometry, regularly in Winter Semester		
Term	1-4		
Language of Instruction	German		
Forms of Teaching and Learning	• Algebraic Structures, Lecture 2 SWS + Ex.cl. 1 SWS • Introduction to Galois Theory, Lecture 2 SWS + Ex.cl. 1 SWS • Introduction to Geometry, Lecture 2 SWS + Ex.cl. 1 SWS		
Content	• Algebraic Structures – Groups, subgroups, group homomorphisms, normal subgroups, quotient group. – Cyclic groups and the symmetric group. – Commutative rings with one, divisibility. – Euclidean rings, principal ideal domains, factorial rings. – The ring of integers and the polynomial ring. • Introduction to Galois Theory – Fields and field extensions. – Fundamental theorem of Galois theory and applications, in particular: * Constructions with ruler and compass. * Solvability of equations. • Introduction to Geometry – Selected topics in geometry from the following canon are covered: * Axiomatic foundation of planar geometry. * Euclidean geometry. * Non-Euclidean geometry. * Analytic geometry. * Parametrised curves and surfaces.		

Objectives

The students deepen their structural thinking, are familiar with fundamental algebraic concepts and can apply them to other mathematical disciplines. They understand, in particular through the example of field theory, how the interplay of different branches of algebra leads to new insights, including answers to classical questions from antiquity. In this context, they have experienced that the interaction of various areas of mathematics can be essential for solving concrete problems. They have become acquainted with a systematic approach to questions of geometry within a selected topic area and can apply methods from other areas of mathematics in geometry. They are familiar with the most fundamental statements and methods of these fields. Their capacity for abstraction has been enhanced, they have been trained in analytical thinking, and their mathematical imagination has been stimulated. Through a proof- and structure-oriented approach they have learnt to follow mathematical proofs in algebra and geometry and to prove or refute mathematical statements independently. They are able to place the structures studied in linear algebra in a broader context and to achieve a deeper understanding of them.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students was trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Algebraic Structures	L	o	2	3	yes	or.	20-30	g	100
	E	o	1	1,5					
Introduction to Galois Theory	L	o	2	3	yes				
	E	o	1	1,5					
Introduction to Geometry	L	o	2	3	yes				
	E	o	1	1,5					

In each of the three submodules, an exercise certificate is required as course work. The assessment of the module takes the form of an oral examination covering all submodules. Admission to the oral examination requires at least two of the three exercise certificates. The module is deemed completed only once all three exercise certificates have been obtained and the oral examination has been passed.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature	**Possible References :** • Serge Lang: Algebraische Strukturen. Vandenhoek & Ruprecht 1979. • Siegfried Bosch: Algebra. Springer 2009. • Gerd Fischer, Reinhard Sacher: Einführung in die Algebra. Teubner 1983. • Christian Karpfinger, Kurt Meyberg: Algebra: Gruppen-Ringe-Körper. Springer Spektrum 2010. • Hans-Jörg Reiffen, Günter Scheja, Udo Vetter: Algebra. Bibliographisches Institut 1984. • Michele Audin: Geometry. Springer 2003. • Marcel Berger: Geometry Revealed: A Jacob's Ladder to Modern Higher Geometry. Springer 2010. • David A. Brannan, Matthew F. Esplen, Jeremy J. Gray: Geometry. Cambridge University Press 2012. • John Stillwell: The four pillars of geometry. Springer 2005.
Transfer	-
Prerequisites	There are no further prerequisites.
Responsible Persons	Daniele Agostini, Carla Cederbaum, Jürgen Hausen, Hannah Markwig, Thomas Markwig, Walther Paravicini

Abbreviations:

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Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-20-12</td><td colspan="2">Module Title:
Stochastics</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td>Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Summer Semester</td></tr>
<tr><td>Term</td><td colspan="3">1-4</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture 4 SWS + Ex.cl. 2 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Introduction to probability theory and statistics.
• Topics from probability theory: Probability spaces, simple conditional probabilities, urn models, random variables, distribution functions, discret and continous distributions, expectation and variance, inequalities, independence, joint probability distribution, notions of convergence, laws of lagre numbers, central limit theorem.
• Topics from statistics: Point estimators, hypothesis testing, standard testing methods.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students know the basic principles of stochastics. They have the ability to abstract stochastic questions and are capable of using their knowledge on specific problems.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students were trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Stochastics</td><td>L</td><td>o</td><td>4</td><td>6</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">90-180 o. 20-30</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>2</td><td>3</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired. Whether the examination is written or oral is decided by the instructor with approval by the head of the examination board.</td></tr>
<tr><td>Literature</td><td colspan="3">Possible References :
• Hans-Otto Georgii: Stochastik. De Gruyter 2015.
• Ulrich Krengel: Einführung in die Wahrscheinlichkeitstheorie und Statistik. Vieweg 2005.</td></tr>
<tr><td>Transfer</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="3">Prior knowledge of the submodule Measure and Integration Theory is assumed.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Martin Möhle, Elmar Teufl</td></tr>
</table>

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-20-13</td><td colspan="2">Module Title:
Numerical Mathematics</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td>Time in Class:
60 h</td><td>Self-Study:
120 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">1-4</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">• Introduction to Numerical Mathematics, Lecture 2 SWS + Ex.cl. 1 SWS
• Mathematical Software, Practical course 1 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Interpolation and approximation of functions.
• Numeric integration and differentiation.
• Systems of linear equations and linear curve fitting.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students know the foundations of numerical mathematics and are capable of performing basic calculation techniques. They understand to bring the knowledge gathered in the modules Analysis and Linear Algbra in the analysis of numerical methods and to use the methods for specific problems. Their algorithmic thinking was enhanced and they are acquainted to the analysis of algorithms with a view to questions of efficiency and complexity.
In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods of the lecture. Furthermore the presentation and communication skills of the students were trained by written assignments and presenting their own solutions. The students are capable of adopting knowledge by self-study and at the same time their capacity for teamwork was enhanced by working in small groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Introduction to Numerical Mathematics</td><td>L</td><td>o</td><td>2</td><td>3</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">90-180 o. 20-30</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>1</td><td>1,5</td></tr>
<tr><td>Mathematical Software</td><td>P</td><td>o</td><td>1</td><td>1,5</td><td>yes</td><td>-</td><td>-</td><td>nb</td><td>0</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired. Whether the examination is written or oral is decided by the instructor with approval by the head of the examination board.</td></tr>
<tr><td>Literature</td><td colspan="3">Possible References :
• Peter Deuflhard, Andreas Hohmann: Numerische Mathematik 1. De Gruyter 2008.
• Martin Hanke-Bourgeois: Grundlagen der Numerischen Mathematik und des Wissenschaftlichen Rechnens. Vieweg+Teubner 2009.</td></tr>
<tr><td>Transfer</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="3">There are no prerequisites.</td></tr>
</table>

Responsible Persons	Christian Lubich, Andreas Prohl

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-20-20	**Module Title:** Introductory Seminar: Presentations in Mathematics		**Type of Module:** Compulsory Module with Choice
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every Semester		
Term	2-4		
Language of Instruction	German		
Forms of Teaching and Learning	Introductory seminar, talk, presentation, e-learning, blended learning		
Content	Various topics from the foundations of mathematics.		
Objectives	The students independently work on a coherent mathematical topic and prepare it in a didactical appealing form. They learn how to present their work to a group, how to be responsive to questions regarding the content and how to lead a professional discussion.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Introductory Seminar	PS	o	2	3	yes	Pr	60-90	g	100

The acquisition of the credit points requires alongside with a successfull presentation the regular active participation in the course, like by asking questions, contributing to a discussion or working on problem tasks. Additionally a written elaboration of the own talk or the issue of a handout for the participants may be required. This further work constitutes the coursework of the module.

Transfer	-
Prerequisites	There are no prerequisites.
Responsible Persons	The dean of studies at the Department of Mathematics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 3: 2nd Subject Physics

<table>
<tr><td>Module Number:
BLP102</td><td colspan="2">Module Title:
Physics Basic Analytical Mechanics</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td>Time in Class:
60 h</td><td>Self-Study:
120 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">1-2</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise classes, independent study, group work</td></tr>
<tr><td>Content</td><td colspan="3">malisms, symmetries and conservation laws, phase space, canonical transformations.
Constraints, D’Alembert’s principle, variational principle, Lagrangian and Hamiltonian for-</td></tr>
<tr><td>Objectives</td><td colspan="3">Students understand the fundamental methods and concepts analytical mechanics. They recognise the relationship between physical experiments and the corresponding mathematical formulations. Students are able to reproduce the content of analytical mechanics covered in the lectures. They can formulate and approximately solve simple physical problems mathematically. For all topics, they use appropriate technical language and mathematical methods. They are able to communicate in a generally understandable way about physical facts of classical physics and compare their models.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Physics Basic Analytical Mechanics</td><td>L</td><td>o</td><td>2</td><td>4</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">-</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>1</td><td>2</td></tr>
</table>
Admission to the examination requires obtaining the course work through successful participation in the exercises. Details will be announced at the start of the course.
</td></tr>
<tr><td>Transfer</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="3">Knowledge from the modules Physics Basic Course 1, Physics Basic Course 2, Mathematics for Natural Scientists 1, and Mathematics for Natural Scientists 2 is required.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Lecturers from the Department of Physics</td></tr>
<tr><td colspan="4">Abbreviations:
Grading System : g=graded, ng=not graded
Examination Type : MT=master’s thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week</td></tr>
</table>

<table>
<tr><td>Module Number:
BLP103</td><td colspan="2">Module Title:
Physics Basic Course Optics and Advanced Study</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td>Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">1-2</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise classes, independent study, group work</td></tr>
<tr><td>Content</td><td colspan="3">• Optics
– Electromagnetic theory of light, phase and group velocities, dispersion of light in a medium, refractive index, geometric optics (Fermat’s principle), instruments of geometric optics, diffraction at a slit, gratings, coherence of light waves, interference, polarisation, X-rays.
• Advanced study in an area of physics by attending a suitable lecture from the Department of Physics’ course offerings.</td></tr>
<tr><td>Objectives</td><td colspan="3">Students understand the fundamental methods and concepts of optics and a further area of physics. They recognise the relationship between physical experiments and the corresponding mathematical formulations. Students are able to reproduce the content of optics and a further area of physics covered in the lectures. They can formulate and approximately solve simple physical problems mathematically. For all topics, they use appropriate technical language and mathematical methods. They are able to communicate in a generally understandable way about physical facts of classical physics and compare their models.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Physics Basic Course Optics</td><td>L</td><td>o</td><td>3</td><td>4</td><td rowspan="2">yes</td><td rowspan="2">wr. o. or.</td><td rowspan="2">-</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>1</td><td>2</td></tr>
<tr><td>Advanced Studies</td><td>L</td><td>o</td><td>2</td><td>3</td><td>yes</td><td>-</td><td>-</td><td>nb</td><td>0</td></tr>
</table>
Credits are earned through the oral exam Synopsis of Classical Physics, which lasts 60 minutes and covers both experiment and theory. To be admitted to the synopsis, it is necessary to pass the exams in Optics and Analytical Mechanics. To be admitted to the exams, attendance in the exercise classes and submission of more than 50% of the assignments are required.</td></tr>
<tr><td>Transfer</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="3">Knowledge from the modules Physics Basic Course 1, Physics Basic Course 2, Mathematics for Natural Scientists 1, and Mathematics for Natural Scientists 2 is required.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Lecturers from the Department of Physics</td></tr>
</table>

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP104	**Module Title:** Modern Physics A		**Type of Module:** Compulsory Module with Choice
ECTS-Points	12		
Workload - Time in Class - Self-Study	Workload: 360 h	Time in Class: 120 h	Self-Study: 240 h
Duration	2 Semester		
Frequency	regularly in Winter Semester		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, independent study, group work		
Content	Quantum Mechanics, Atomic Physics, and Quantum Optics: • Postulates of quantum mechanics, single-particle potential models, Schrödinger and Heisenberg equations, particle-wave duality, spin, measurement process, quantum mechanical states, spectra and selection rules of atoms and atomic nuclei, non-locality, many-body problem, lasers, quantum optics.		
Objectives	Students are familiar with concepts of modern quantum and atomic physics. They can formulate simple physical problems mathematically and use appropriate technical language in doing so.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Modern Physics A (Quantum Mechanics and Atomic Physics)	L	o	6	9	yes	wr.	-	g	100
	E	o	2	3					

Credits are earned through an exam. To be admitted to the exam, attendance in the exercise classes and submission of more than 50% of the assignments are required.

Transfer	-
Prerequisites	Knowledge from the modules Physics Basic Course 1-2 and Mathematics for Scientists 1-2, as well as the modules Physics Basic Course 3 and Experimental Physics 1, is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP105A	**Module Title:** Physics Laboratory A		**Type of Module:** Compulsory Module
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	1-2		
Language of Instruction	German		
Forms of Teaching and Learning	Practical work, independent study, group work		
Content	Conducting physical experiments in optics, mechanics, and electrical engineering.		
Objectives	Students • know the basics of conducting experiments; • are able to follow instructions; • can present results both in writing and orally.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Physics Laboratory A	P	o	4	6	-	-	-	ng	-

Transfer	-
Prerequisites	Knowledge from the modules Physics Basic Course 1 and Mathematics for Natural Scientists 1 is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP106BD	**Module Title:** Physics Laboratory B and Demonstration Laboratory		**Type of Module:** Compulsory Module
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	every Semester		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Practical work, independent study, group work		
Content	Conducting physical experiments in optics, mechanics, and electrical engineering.		
Objectives	Students • know the basics of conducting experiments; • are able to follow instructions; • can present results both in writing and orally; • develop advanced software skills for data collection and analysis; • are familiar with statistical methods for determining measurement uncertainties.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Physics Laboratory B	P	o	2	3	-	-	-	ng	-
Demonstration Laboratory	P	o	2	3	-	-	-	ng	-

Transfer	-
Prerequisites	Knowledge from the modules Physics Basic Course 1 and Mathematics for Scientists 1, as well as the module Experimental Physics 1, is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MLP114</td><td colspan="3">Module Title:
Modern Physics D</td><td>Type of Module:
Compulsory Module with Choice</td></tr>
<tr><td>ECTS-Points</td><td colspan="4">6</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
180 h</td><td colspan="2">Time in Class:
90 h</td><td>Self-Study:
90 h</td></tr>
<tr><td>Duration</td><td colspan="4">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="4">every year</td></tr>
<tr><td>Term</td><td colspan="4">3-4</td></tr>
<tr><td>Language of Instruction</td><td colspan="4">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="4">Lecture, exercise classes, independent study, group work</td></tr>
<tr><td>Content</td><td colspan="4">Depending on the choice of course, content may include the following topics:
• Statistical physics
– Temperature and energy, entropy, thermodynamic processes and machines, classical gases and quantum gases, Bose condensation, black-body radiation.
• Solid state physics
– Crystals, diffraction methods, electron conduction, phonons, magnetism, semiconductors, nanostructures.
• Nuclear and particle physics
– Building blocks of matter, reactions, nuclear models, Standard Model of particle physics.
• Astronomy and astrophysics
– Optical devices and instruments, star formation and evolution, Big Bang, black holes, messengers, cosmology.</td></tr>
<tr><td>Objectives</td><td colspan="4">Students master the technical language; they can relate theoretical foundations, experimental evidence, and practical applications. They can summarise and present issues and relationships in a structured manner. They can interpret results from current research. They can apply learned technical methods to their field of work. They can establish connections between various subfields of modern physics and explain their correspondences with classical physics clearly.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="4">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Modern Physics D</td><td>L</td><td>o</td><td>4</td><td>2</td><td rowspan="2">yes</td><td rowspan="2">wr.</td><td rowspan="2">90-180</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>L</td><td>o</td><td>2</td><td>3</td></tr>
</table>
Credit points (ECTS) are earned through regular participation in the classes and by obtaining the course work. Details will be announced at the start of the course.</td></tr>
<tr><td>Transfer</td><td colspan="4">-</td></tr>
<tr><td>Prerequisites</td><td colspan="4">There are no formal prerequisites. However, prior participation in the module Modern Physics A is advisable.</td></tr>
</table>

Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

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Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 4: Didactics

<table>
<tr><td>Module Number:
INFL01</td><td colspan="6">Module Title:
Subject Didactics in Computer Science I</td><td colspan="4">Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="10">3</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td colspan="3">Workload:
90 h</td><td colspan="3">Time in Class:
30 h</td><td colspan="4">Self-Study:
60 h</td></tr>
<tr><td>Duration</td><td colspan="10">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="10">regularly in Summer Semester</td></tr>
<tr><td>Term</td><td colspan="10">1-2</td></tr>
<tr><td>Language of Instruction</td><td colspan="10">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="10">Seminar</td></tr>
<tr><td>Content</td><td colspan="10">Basic planning, organisation and implementation of computer science lessons, knowledge, initial analysis and didactic preparation of suitable practical fields, individual teaching test.</td></tr>
<tr><td>Objectives</td><td colspan="10">The students have specialised didactic knowledge, in particular for determining, selection and justification of objectives, content, methods and media of computer science education.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="10"><table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td>Subject Didactics in Computer Science I</td><td>S</td><td>o</td><td>2</td><td>3</td><td>-</td><td>K o. mP o. R o. H</td><td>-</td><td>g</td><td>100</td></tr>
</table></td></tr>
<tr><td>Transfer</td><td colspan="10">The module is a prerequisite for the modules Subject Didactics in Computer Science II and III.</td></tr>
<tr><td>Prerequisites</td><td colspan="10">There are no prerequisites</td></tr>
<tr><td>Responsible Persons</td><td colspan="10">Klaus Ostermann</td></tr>
<tr><td colspan="11">Abbreviations:
Grading System : g=graded, ng=not graded
Examination Type : MT=master’s thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week</td></tr>
</table>

Module Number: INFL02	**Module Title:** Subject Didactics in Computer Science II		**Type of Module:** Compulsory Module
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, seminar		
Content	Methods and media for teaching computer science content, individual teaching test, use of software packages for teaching selected computer science content, such as Filius.		
Objectives	Students are familiar with subject-specific didactic concepts and can effectively use educational software as well as computer-assisted learning and teaching methods.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics II	L	o	2	4,5	-	K o. mP o. R o. H	-	g	100
	E	o	1	1,5					

Transfer	-
Prerequisites	Knowledge from the module Subject Didactics in Computer Science I is assumed.
Responsible Persons	Klaus Ostermann

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFL03a	**Module Title:** Subject Didactics in Computer Science IIIa (MEd IPM)		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Intensive course		
Content	Didactic (re-)construction of subject knowledge, analysis and evaluation of teaching and learning processes in computer science education, interdisciplinary aspects related to the subject of computer science, project work: development of a teaching unit and implementation through individual presentations.		
Objectives	Students have initial reflective experience in the planning, implementation, and analysis of competence-oriented computer science teaching.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics IIIa	S	o	2	3	-	K o. mP o. R o. H	-	g	100

Transfer	-
Prerequisites	Knowledge from the modules Subject Didactics in Computer Science I and Subject Didactics in Computer Science II is assumed.
Responsible Persons	Klaus Ostermann, Andreas Koch

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-80-01	**Module Title:** Subject Didactics Mathematics 1		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	1-2		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise class, seminar, talk, presentation, e-learning, blended learning, project work, case studies		
Content	**Didactics of Algebra and Arithmetic:** This course deals with the foundations of the didactics of mathematics in the educational plans and in particular the didactic reduction of important basic concepts of algebra and arithmetic to school level, various ways of introducing important concepts of algebra and arithmetic at school and ways of motivating basic algebraic and arithmetic ideas.		
Objectives	Students know the basic didactic principles of teaching concepts and can orientate themselves in the educational plans. They are able to compare and evaluate subject-specific approaches to central concepts in algebra and arithmetic. They have the ability to convey algebraic and arithmetic content in a way that is both student- and subject-orientated.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics Mathematics 1	LIC	o	2	3	no	wr., or., P o. T	90-180 o. 20-30	g	100

Whether the form of the examination is decided by the instructor with approval by the head of the examination board.

Transfer	-
Prerequisites	There are no prerequisites.
Responsible Persons	Frank Loose, Walther Paravicini

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-80-04	**Module Title:** Subject Didactics Mathematics 2 (MEd-IPM)		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every Semester		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise, proseminar, talk, presentation, e-learning, blended learning, project work, case studies		
Content	The module deals with the didactic reduction of important basic concepts of analysis, linear algebra, geometry or stochastics at school level, various options for introducing important terms in analysis, linear algebra, geometry or stochastics at school as well as motivational options for analytical, geometric or stochastic basic ideas.		
Objectives	The students know the didactic basic principles of teaching concepts. They are able to compare and assess technical approaches to central terms in analysis, linear algebra or stochastics. They have the ability to convey analytic, algebraic or stochastic content		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics Mathematics 2 – Part 1 or 2	SV	o	2	3	yes	K o. mP o. R o. H	90-180 o. 20-30	g	100

Transfer	-
Prerequisites	If a course on didactics of geometry and linear algebra is chosen, the module Geometry should be taken parallel or prior to this course as knowledge from the module Geometry will be required.
Responsible Persons	Frank Loose, Walther Paravicini

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MAT-80-05</td><td colspan="2">Module Title:
Subject Didactics Mathematics 3: Professional Knowledge</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">3</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
90 h</td><td>Time in Class:
30 h</td><td>Self-Study:
60 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">3-4</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise, proseminar, talk, presentation, e-learning, blended learning, project work, case studies</td></tr>
<tr><td>Content</td><td colspan="3">Varying topics are covered, who are especially related to the teaching profession and are also suited for a didactical refurbishment of the school internship semester.</td></tr>
<tr><td>Objectives</td><td colspan="3">The students
know subject didactical principles and education concepts and can evaluate and scrutinize them,
can compare and evaluate subject related approaches to central terms and theorems of the treated fields,
can plan, execute, analyse and evaluate competence oriented mathematical education on the basis of subject didactical concepts,
can motivate the general educating value of mathematical contents and methods and the social importance of mathematics and put it in context with the goals and contents of mathematical education,
can specifically use subject specific media,
can create a portfolio ans document important experiences, findings and insights in a tructured manner.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3"><table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td>Subject Didactics Mathematics 3: Professional Knowledge</td><td>S</td><td>o</td><td>2</td><td>3</td><td>yes</td><td>K o. mP o. R o. H</td><td>90-180 o. 20-30</td><td>g</td><td>100</td></tr>
</table></td></tr>
<tr><td>Transfer</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="3">There are no prerequisits.</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">Frank Loose, Walther Paravicini</td></tr>
</table>

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-80-06	**Module Title:** Subject Didactics Mathematics 3: Elective Specialisation		**Type of Module:** Compulsory Module with Choice
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise class, proseminar, lecture, presentation, e-learning, blended learning, project work, case studies		
Content	Changing topics in the didactics of mathematics are dealt with, which can lead to current research in the didactics of mathematics.		
Objectives	The students • can compare and assess technical approaches to central concepts and sentences in the areas covered, • can explain the general educational content of mathematical content and methods and the social significance of mathematics and place it in the context of the objectives and content of mathematics lessons, • can use subject-specific media in a targeted manner, • can create a portfolio and document significant experiences, and insights in a structured manner.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics Mathematics 3: Elective Specialisation	S	o	2	3	yes	K o. mP o. R o. H	90-180 o. 20-30	g	100

Transfer	-
Prerequisites	The modules Didactics of Mathematics 1 and Didactics of Mathematics 2 (ME-IPM) are a prerequisite.
Responsible Persons	Frank Loose, Walther Paravicini

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP105F	**Module Title:** Subject Didactics in Physics 1		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	1-2		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, presentation, independent study, group work		
Content	Basics of subject didactics, subject-specific working and thinking methods, students' preconceptions and learning difficulties, subject-specific reduction.		
Objectives	Students • are familiar with the subject-specific didactic content; • understand concepts of subject-specific education; • recognise the importance of experimentation.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics 1	S	o	2	3	-	wr. o. or.	-	g	100

Transfer	-
Prerequisites	Knowledge from the modules Physics Basic Course 1 and Mathematics for Scientists 1 is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP106F	**Module Title:** Subject Didactics Physics 2		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, presentation, practical work, independent study, group work		
Content	Planning and analysing physics lessons with special consideration of competence orientation, heterogeneity and gender aspects, task culture in physics lessons.		
Objectives	Students • can link the didactic learning content and apply it appropriately to the situation; • know the importance of experimentation; • are familiar with lesson planning; • know concepts for designing a lesson (preparation for School Internship Semester).		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics 2	S	o	2	3	-	wr. o. or.	-	g	100

Transfer	-
Prerequisites	Previous participation in the module Didactics of Physics 1 is desirable, but not mandatory. Knowledge from the modules Physics Basic Course 1 and Mathematics for Scientists 1 is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP106S	**Module Title:** Subject Didactics in Physics 3 (MEd-IPM)		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	2-3		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, presentation, practical work, independent study, group work		
Content	Planning and analysing physics lessons with special consideration of competence orientation, heterogeneity and gender aspects, task culture in physics lessons, carrying out student experiments.		
Objectives	Students • can link the didactic learning content and apply it appropriately to the situation; • recognise the importance of experimentation; • are familiar with lesson planning; • know concepts for structuring a lesson (preparation for the practical semester).		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics 3	S,P	o	2	3	-	wr. o. or.	-	g	100

Transfer	-
Prerequisites	Prior participation in the modules Didactics of Physics 1 and Didactics of Physics 2 (MEd-IPM) is desirable but not mandatory. Knowledge from the modules Physics Basic Course 1 and Mathematics for Scientists 1 is required.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

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Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MLP10F	**Module Title:** Subject Didactics in Physics 4		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Seminar, exercise classes, portfolio		
Content	Reflection on the School Internship Semester, documentation of the portfolio.		
Objectives	Students evaluate the didactic concepts of experimentation at school and reflect on communication methods and active participation in scientific opinion formation. They can create a structured portfolio and document their findings.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics 4	SÜ	o	2	3	-	-	-	ng	-

Transfer	-
Prerequisites	Prior participation in the modules Didactics of Physics 1 and Didactics of Physics 2 (MEd-IPM) is desirable but not mandatory.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MLP12F	**Module Title:** Subject Didactics in Physics 5		**Type of Module:** Compulsory Module
ECTS-Points	3		
Workload - Time in Class - Self-Study	Workload: 90 h	Time in Class: 30 h	Self-Study: 60 h
Duration	1 Semester		
Frequency	every year		
Term	3-4		
Language of Instruction	German		
Forms of Teaching and Learning	Seminar, exercise classes, independent study, group work, portfolio		
Content	Experimentation in student-oriented teaching.		
Objectives	Students can plan a coordinated lesson. They are able to use modern media in teaching.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Subject Didactics 5	SÜ	o	2	3	-	wr. o. or.	-	g	100

Transfer	-
Prerequisites	Prior participation in the modules Didactics of Physics 1 and Didactics of Physics 2 (MEd-IPM) is desirable but not mandatory.
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 5: Education

Module Number: **BWS-ME0**	**Module Title:** Educational Sciences 1 (MEd-IPM)		**Type of Module:** Compulsory Module
ECTS-Points	5		
Workload **- Time in Class** **- Self-Study**	Workload: 150 h	Time in Class: 60 h	Self-Study: 90 h
Duration	2 Semester		
Frequency	every Semester		
Term	1-2		
Language of Instruction	German or English		
Forms of Teaching and Learning	Lecture, seminar		
Content	The lecture introduces the Tübingen teacher training programme (topics and organisation) and the study of educational science. Selected topics and tasks of the teaching profession (e.g. school as a workplace, tasks of the teaching profession, professionalisation theories) as well as central topics of the micro, meso and macro level (teaching, school, school system) are examined in depth. The introduction includes basic concepts and theories (e.g. teaching theory/didactics, education, educational inequality, upbringing, socialisation, anthropology). The lecture provides an introduction to the school internship semester (e.g. criteria and methods of observation and documentation) as well as to theory-based, empirical and development-related work in the educational sciences. The compulsory portfolio is introduced on the basis of specific objectives, functions and methods of documentation. The compulsory seminar Profession and Professionalism II introduces students to the academic discourse on the teaching profession, the theory and empirical research on professionalism in the teaching profession and also to teaching research. Contents include, for example, lesson planning and teaching concepts, characteristics and framework conditions of the teaching profession, professional biographies of teachers, research on teacher behaviour, stress and strain in the teaching profession, teaching quality, classroom management and communication and interaction in the classroom. The school internship semester is initiated.		

Objectives

The students

- are familiar with the concept of the Tübingen teacher training programme;
- are able to reproduce and differentiate between basic educational science terms and theories;
- recognise the levels of the education system relevant to educational processes and quality development in schools based on selected topics;
- are able to distinguish between theoretical and empirical research work and practical challenges based on selected topics and tasks in the teaching profession;
- know the objectives, subject areas and organisation of the orientation internship as well as their tasks during the internship;
- can create their portfolio and document significant experiences, findings and insights in a structured manner;
- know models of lesson planning, lesson concepts and didactic principles;
- know selected findings of empirical professional research;
- know analysis categories of teaching research and are able to use them to reflect on observed lessons;
- reflect on their career choice against the background of practical experiences and their contextualisation in academic discourse;
- are able to use their portfolio as a medium for reflecting on their professional biographical development and career choice.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Introduction to the Study of Educational Sciences	L	o	2	3	-	wr. o. or.	je nach Art	g	100
Profession and Professionalism II	S	o	2	2	-	-	-	nb	-

Transfer

-

Prerequisites

There are no prerequisites

Responsible Persons

-

Abbreviations:

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Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: **BWS-ME1**	**Module Title:** School Pedagogy I		**Type of Module:** Compulsory Module
ECTS-Points	6		
Workload **- Time in Class** **- Self-Study**	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	2 Semester		
Frequency	every Semester		
Term	1-2		
Language of Instruction	German or English		
Forms of Teaching and Learning	Seminar / portfolio work, case work		
Content	In the seminar School Practice in Theory and Research, students prepare for the school practise semester and research one aspect of the school practice semester on the basis of theory and empirical research. In the seminar Micro Level: Teaching in Theory and Research, the subject area of teaching is dealt with, deepened using exemplary theories and empirical approaches and reflected on in the portfolio. The courses are coordinated with the seminars in sub-module 1b and serve the cumulative acquisition of skills following on from the the acquired orientation knowledge.		
Objectives	The students • know the general didactic foundations of lesson planning; • know methods of lesson observation and diagnostics; • know the foundations of pedagogical diagnostics, support and learning guidance; • are able to prepare a case description of their own teaching (school internship semester), document it in the portfolio and reflect on this case against the background of scientific theories and models in a criteria-led (research-based) manner; • are familiar with selected didactic models and teaching concepts; • are able to reflect on their own subjective theories in the portfolio; • know central aspects of research on teaching quality; • know central aspects of classroom management; • are familiar with the discourse on tasks and task culture (e.g. learning tasks, examination tasks, homework); • are able to reflect on appropriate ways of dealing with heterogeneity in schools and lessons; • know the advantages and disadvantages of more open and more closed forms of teaching; • know central aspects of performance assessment and are able to understand these using examples.		

Requirements for obtaining Credits / Grading (Weighting if applicable)	Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
	School Practice in Theory and Research	S	o	2	2	-	-	-	nb	-
	Micro Level: Teaching in Theory and Research	S	o	2	4	-	mP o. K	je nach Art	g	100
Transfer	-									
Prerequisites	Knowledge of the BWS-ME0 module is assumed.									
Responsible Persons	-									

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: **BWS-ME3**	**Module Title:** Inclusion, Diversity, and Heterogeneity		**Type of Module:** Compulsory Module with Choice
ECTS-Points	6		
Workload **- Time in Class** **- Self-Study**	Workload: 150 h	Time in Class: 60 h	Self-Study: 90 h
Duration	2 Semester		
Frequency	every Semester		
Term	2-3		
Language of Instruction	German or English		
Forms of Teaching and Learning	Lecture, seminar		
Content	The module prepares students for the challenges of difference- and inclusion-oriented school education under the conditions of social differentiation and social inequality. In the introductory lecture, phenomena of diversity, heterogeneity and inequality are examined from a social, cultural and educational science perspective in terms of basic theory as well as empirically, and examples are analysed in depth. Subsequently, processes of inclusion and exclusion in a social and institutional context are analysed. In the compulsory elective lecture or the compulsory elective seminar *Inclusion, Diversity and Heterogeneity in the School Context*, the institutional framework conditions for inclusion in the school system are reflected upon in depth and perspectives on inclusive school and teaching development are developed. In the compulsory elective course *Linguistic Heterogeneity*, students specialise in the area of language. The focus is on the professional handling of linguistic heterogeneity in schools and specialised teaching. On the one hand, students learn about the educational language requirements of schools and, on the other hand, about the acquisition of the language skills necessary for success at school and about possible impairments in the acquisition process (e.g. due to dyslexia). In addition, students gain insights into various language acquisition scenarios and learn which factors influence the development of multilingualism and how, in order to be able to derive recommendations for action in schools. Taking various subjects into account, students are introduced to methods of language-sensitive and language-promoting lesson planning using practical examples.		

Objectives

The students

- know the basics of theoretical and empirical approaches to diversity, heterogeneity and social inequality in their interdisciplinary breadth;
- deal with the relationship between inclusion and exclusion in society and the education system;
- are able to reflect on inclusion against the background of social and educational phenomena of diversity and heterogeneity;
- can relate questions of educational inequality and educational equity to their future actions as a teacher;
- deal with aspects of migration, flight and interculturality;
- deal with different concepts of sex and gender and concepts of sexual identity;
- deepen or expand their knowledge and skills in an area of their choice by
  - developing a complex and reflective understanding of processes of inclusion and exclusion in the school context and of concepts of inclusive school and lesson development, thereby gaining diversity- and heterogeneity-sensitive pedagogical orientation knowledge
  - **or** get to know the manifestations of linguistic heterogeneity that can be found in everyday life at grammar school in order to acquire a repertoire of methods that will enable them to analyse teaching materials for potential linguistic difficulties and to design language-sensitive subject lessons that are able to respond adequately to the needs of a linguistically heterogeneous student body.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Introduction to the Topics of Inclusion, Diversity and Heterogeneity	L	o	2	3	-	wr.	60 min	g	100
Linguistic Heterogeneity *or* Inclusion, Diversity and Heterogeneity in the School Context	L	f	2	3	-	-	-	nb	-

Transfer

-

Prerequisites

Knowledge of the BWS-ME0 module is assumed.

Responsible Persons

-

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BWS-ME4	**Module Title:** Empirical Educational Research and Educational Psychology		**Type of Module:** Compulsory Module
ECTS-Points	6		
Workload - Time in Class - Self-Study	Workload: 180 h	Time in Class: 60 h	Self-Study: 120 h
Duration	2 Semester		
Frequency	every Semester		
Term	3-4		
Language of Instruction	German or English		
Forms of Teaching and Learning	Lecture, seminar		
Content	The module provides an overview of the concepts and findings of empirical educational research and educational psychology. The focus is on psychological aspects of teaching and learning. These include, among others: classical and modern learning theories; intelligence concepts and giftedness; psychology of personality; self-regulated learning and learning strategies; motivation and emotion in educational contexts; school-related self-concepts; interest and expectancy-value model(s); psychological aspects of teaching quality; professional competence of teachers; social disparities and gender differences in the school context; effectiveness in the education system; fundamentals of educational-psychological diagnostics; experimental planning and designs of empirical studies in educational research and educational psychology.		
Objectives	The students • have practical knowledge of central fields of pedagogical-psychological research and empirical educational research on the basis of this module; • are able to reflect on and apply what they have learnt with regard to educational fields of practice; • are familiar with the basic methodological concepts of empirical research and are able to interpret the results of empirical studies.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Introduction to educational psychology	L	o	2	2	-	wr.	120 min	g	100
Core Topics of Empirical Educational Research and Educational Psychology	SV	o	2	2	-				
Module Exam	-	o	-	2	-				

Transfer	-
Prerequisites	Knowledge of the BWS-ME0 module is assumed.
Responsible Persons	-

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 6: School Practise Semester

The School Practise Semester can only be completed in a winter semester, and prior to that, students should have completed coursework in subject didactics in both subjects as part of their Master's studies. If starting in the winter semester, it is recommended to complete the School Practise Semester in the third semester; if starting in the summer semester, it is recommended to complete it in the second or in the fourth semester. The School Practise Semester begins each September with the start of the new school year and lasts for 12 weeks. During this time, students are supervised by a State Seminar for Didactics and Teacher Education (Gymnasium) affiliated with the school, and they attend accompanying events at the seminar throughout the entire practise period. Students are informed about the application procedure for the School Practise Semester at the beginning of their studies. Further information about the School Practise Semester can be found in the publications of the Ministry of Education under the following link:

https://lehrer-online-bw.de/schulpraktika.

Module Number: **SP**	**Module Title:** School Practice Semester									**Type of Module:** Compulsory Module
ECTS-Points	16									
Workload - Time in Class - Self-Study	Workload: 480 h	Time in Class: 120 h								Self-Study: 360 h
Duration	1 Semester									
Frequency	regularly in Winter Semester									
Term	2-3									
Language of Instruction	German									
Forms of Teaching and Learning	School Internship									
Content	School Internship									
Objectives	School Internship									
Requirements for obtaining Credits / Grading (Weighting if applicable)	Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
	School Practice Semester	-	o	-	16	-	-	-	-	100
Transfer	-									
Prerequisites	One subject didactics module in each subject, as well as the module BWS-ME0, is required.									
Responsible Persons	-									

Abbreviations:

Grading System	: g=graded, ng=not graded
Examination Type	: MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format	: L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status	: o=obligatory, f=facultative
Other	: h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 7: Master Thesis

The Master's thesis is the final part of the Master's programme and can be completed in one of the two subjects (including subject didactics), but not in the educational sciences. If the Master's thesis is on a subject didactics topic, it will be completed in the subject whose didactics is the main focus of the thesis.

Module Number: INFL31	**Module Title:** Master Thesis Computer Science		**Type of Module:** Compulsory Module
ECTS-Points	15		
Workload - Time in Class - Self-Study	Workload: 450 h	Time in Class: regularly, as required	Self-Study: 450 h
Duration	1 Semester		
Frequency	every Semester		
Term	4		
Language of Instruction	German		
Forms of Teaching and Learning	Master thesis, Independent study		
Content	The Master's thesis can be written in Computer Science in the case of a subject combination with Computer Science.		
Objectives	In the master's thesis, students demonstrate that they have mastered the fundamentals of academic research in computer science and can independently, comprehensively, and problem-orientedly address an academic question within a limited time frame and present it appropriately.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Master Thesis	MT	o	-	15	no	MT	-	g	100

Transfer	-
Prerequisites	A subject-specific requirement for admission to the master thesis module, in addition to the general conditions stated in the study and examination regulations, is the attainment of at least 36 credits from the second subject area and at least 15 credits from the subject didactics area.
Responsible Persons	The dean of studies

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MAT-40-54	**Module Title:** Master Thesis		**Type of Module:** Compulsory Module
ECTS-Points	15		
Workload - Time in Class - Self-Study	Workload: 450 h	Time in Class: regularly, as required	Self-Study: 450 h
Duration	1 Semester		
Frequency	every Semester		
Term	4		
Language of Instruction	German		
Forms of Teaching and Learning	Master thesis		
Content	The master's thesis represents the culmination of the master's degree programme. Under the guidance of a supervisor, students are required to work on a well-defined problem in mathematics (including mathematics education), which may extend to the frontiers of current research. This involves using scientific methods and presenting the results in written form. Specifically, this includes: • formulating a scientific research question in consultation with the supervisor; • independently searching for and studying relevant scientific literature; • formulating appropriate research questions and methodological approaches for their solution; • independently carrying out the project, as well as presenting the project and its results in writing and, if applicable, orally, within the context of the current state of research. The results should contribute to scientific knowledge.		
Objectives	The students: • are capable of familiarising themselves with a problem, which may extend to the frontiers of current research, within a given timeframe and independently developing a solution approach, • can increasingly apply appropriate scientific methods independently and present the results in a scientifically appropriate manner, • are able to independently work on a scientific topic while applying their mathematical methodological knowledge, • deepen their problem-solving skills and can transfer their methodological knowledge, • are able to present the results of their project to a professional audience.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Master Thesis	MT	o	-	15	yes	MT	-	g	100

The coursework consists of an examination interview on the contents of the master thesis. The coursework is graded as pass or fail. The module grade is the grade for the master thesis. The module is only passed if the examination and coursework have been successfully completed.

Transfer	-
Prerequisites	In addition to the requirements mentioned in the general part of the study and examination regulations, the technical admission requirement for admission to the master's thesis module is the acquisition of at least 36 credit points from the second subject area and at least 15 credit points from the subject didactics area.
Responsible Persons	The dean of studies at the Department of Mathematics

Abbreviations:

Grading System : g=graded, ng=not graded

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Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: MLP13	**Module Title:** Master Thesis (Physics)		**Type of Module:** Compulsory Module
ECTS-Points	15		
Workload - Time in Class - Self-Study	Workload: 450 h	Time in Class: 50 h	Self-Study: 400 h
Duration	1 Semester		
Frequency	every Semester		
Term	4		
Language of Instruction	German		
Forms of Teaching and Learning	Master thesis, independent study, discussion with the supervisor, presentation		
Content	Preparation of a scientific paper (master's thesis, processing time 16 weeks). The master's thesis can be written in physics in the case of a subject combination with physics. It may also include subject-related didactic elements.		
Objectives	Students grasp the fundamentals of scientific research and acquire an understanding of science. They are able to independently, comprehensively, and problem-orientedly address an academic question within a limited time frame and can appropriately formulate and present their findings in a written report.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Master Thesis	MT	o	-	15	no	MT	-	g	100

The results of the master's thesis are presented in the research group.

Transfer	-
Prerequisites	A subject-specific requirement for admission to the Master thesis module, in addition to the general requirements stated in the study and examination regulations, is the attainment of at least 36 credits from the second subject area and at least 15 credits from the subject didactics area.
Responsible Persons	The dean of studies

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Section 8: Requirements

Depending on the combination of subjects, certain requirements must have already been fulfiled in the chosen second subject as part of the Bachelor of Science programme that qualifies for admission to this programme. These are listed in Section 2.3 for each subject combination. For completeness, we list the module descriptions of the modules of the second subjects listed as admission requirements in Section 2.3. These or equivalent requirements may also be imposed if necessary.

<table>
<tr><td>Module Number:
BLP01</td><td colspan="2">Module Title:
Physics Basic Course 1</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">12</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
360 h</td><td>Time in Class:
135 h</td><td>Self-Study:
225 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regularly in Winter Semester</td></tr>
<tr><td>Term</td><td colspan="3">-</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture, exercise classes, independent study, group work</td></tr>
<tr><td>Content</td><td colspan="3">• Mechanics
– Space, time, measurement, coordinate systems, vectors, Newton’s equations of motion, force, conservative force fields, work (line integrals, gradient), solution of equations of motion (differential equations), harmonic oscillator, with damping, driven oscillator (complex numbers), law of gravitation, Kepler’s laws, angular momentum, many-body systems, centre of mass, rigid body (volume integrals), moment of inertia tensor, rotations (orthogonal transformations), fictitious forces, gyroscopes, vibrations and waves, acoustics, Fourier decomposition.
• Thermodynamics
– Temperature, heat capacity, Boltzmann distribution, ideal gas, barometric height formula, entropy, heat engines, phase transitions.</td></tr>
<tr><td>Objectives</td><td colspan="3">Students understand the fundamental methods and concepts of mechanics and thermodynamics. They recognise the relationship between physical experiments in mechanics/thermodynamics and mathematical formulations. Students are able to reproduce and explain the content covered in the lectures using examples. They can formulate and solve simple physical problems mathematically, either exactly or approximately. For all topics, they use appropriate technical language and mathematical methods.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Physics Basic Course 1</td><td>L</td><td>o</td><td>6</td><td>9</td><td rowspan="2">yes</td><td rowspan="2">wr.</td><td rowspan="2">-</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>3</td><td>3</td></tr>
</table>
Admission requirement for the module exam (two exams) is successful participation in the exercise classes. Details such as the weighting of the exams will be announced at the start of the course.
</td></tr>
</table>

Transfer	Physics Basic Courses in the Bachelor's programme and in the teaching programmes for physics and astronomy.
Prerequisites	none
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: BLP02	**Module Title:** Physics Basic Course 2		**Type of Module:** Compulsory Module
ECTS-Points	12		
Workload - Time in Class - Self-Study	Workload: 360 h	Time in Class: 135 h	Self-Study: 225 h
Duration	1 Semester		
Frequency	regularly in Summer Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, independent study, group work		
Content	Electrostatics (surface integrals, rotation, divergence; Stokes' and Gauss' theorems), boundary value problems, multipole expansion, electrostatics in a medium, Ohm's law, magnetostatics, Maxwell's equations, alternating current, inductances, capacitances, complex resistances, simple circuits, electromagnetic waves, special relativity.		
Objectives	Students understand the fundamental methods and concepts of electrodynamics. They have grasped the basic concepts of special relativity. They recognise the relationship between physical experiments in electrodynamics and the corresponding mathematical formulations. Students are able to reproduce and explain the content of electrodynamics and special relativity covered in the lectures using examples. They can formulate and solve simple physical problems mathematically, either exactly or approximately. For all topics, they use appropriate technical language and mathematical methods.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Physics Basic Course 2	L	o	6	9	yes	wr.	-	g	100
	E	o	3	3					

Admission requirement for the module exam (two exams) is successful participation in the exercise classes. Details, such as the weighting of the exams, will be announced at the start of the course.

Transfer	Physics Basic Courses in the Bachelor's programme and in the teaching programmes for physics and astronomy
Prerequisites	none
Responsible Persons	Lecturers from the Department of Physics

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM1010	**Module Title:** Mathematics for Computer Science 1: Analysis		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, excercise class		
Content	Topics include the basics (mathematical reasoning; sets; mappings and relations; natural numbers), real numbers, sequences and series, limits and growth of functions, differential and integral calculus, Taylor expansion.		
Objectives	Students know the basics of analysis, which is an important prerequisite in all areas of computer science. They have the ability to formally correct (mathematical) argumentation and representation. Through working in small exercise groups, students have the ability to to work on problems together and to critically assess solutions of other students. By dealing with strictly formal content and tools, argumentative precision is developed and perseverance is strengthened.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Mathematics for Computer Science 1: Analysis	L	o	4	6	yes	wr.	120	g	100
	E	o	2	3					

Transfer	-
Prerequisites	There are no prerequisites
Responsible Persons	Britta Dorn, Stephan Eckstein

Abbreviations:

Grading System : g=graded, ng=not graded

Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
INFM1020</td><td colspan="3">Module Title:
Mathematics for Computer Science 2: Linear Algebra</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="4">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td colspan="2">Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="4">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="4">regularly in Summer Semester</td></tr>
<tr><td>Term</td><td colspan="4">-</td></tr>
<tr><td>Language of Instruction</td><td colspan="4">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="4">Lecture, exercise classes</td></tr>
<tr><td>Content</td><td colspan="4">Topics include algebra (groups, rings, bodies, polynomial rings, secondary classes and Lagrange’s theorem) and linear algebra (vector spaces, linear mappings and their matrix representation, rank of a matrix, change of basis, orthonormal bases, linear systems of equations and their solution using the Gauß algorithm, determinants, eigenvectors and eigenvalues, orthogonal and symmetrical matrices).</td></tr>
<tr><td>Objectives</td><td colspan="4">Students acquire knowledge of algebraic structures and linear algebra and their applications in computer science. They are able to argue about abstract algebraic structures and can correctly apply the methods and algorithms of linear algebra to solve linear systems of equations and describe geometric situations. After completing this module, students are confident in formally correct mathematical argumentation and its presentation.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="4">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Mathematics for Computer Science 2: Linear Algebra</td><td>L</td><td>o</td><td>4</td><td>6</td><td rowspan="2">yes</td><td rowspan="2">wr.</td><td rowspan="2">120</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>2</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Transfer</td><td colspan="4">-</td></tr>
<tr><td>Prerequisites</td><td colspan="4">INF1010 Mathematics for Computer Science 1 recommended</td></tr>
<tr><td>Responsible Persons</td><td colspan="4">Britta Dorn, Stephan Eckstein</td></tr>
<tr><td colspan="5">Abbreviations:
Grading System : g=graded, ng=not graded
Examination Type : MT=master’s thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests
Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom
Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week</td></tr>
</table>

Module Number: INFM1110	**Module Title:** Practical Computer Science 1: Declarative Programming		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes, presence exercise		
Content	Elements of programming, case distinctions and branching, composite and mixed data, programming with accumulators, higher-order functions, interactive programmes, recursive data structures and recursive functions, pattern matching, designing programmes, design recipes, reduction semantics and programme equivalence.		
Objectives	Students are familiar with design instructions for the systematic design of computer programmes and are able to use them appropriately. They know the characteristics of the functional paradigm and can assess its strengths and limitations. They can structure problems, describe them abstractly and then develop programmes in a disciplined process. They can present their results clearly and explain the details of their solution using specialised terminology.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Practical Computer Science 1: Declarative Programming	L	o	4	6	yes	wr.	90	g	100
	E	o	2	3					

Transfer	-
Prerequisites	There are no prerequisites
Responsible Persons	Klaus Ostermann, Torsten Grust

Abbreviations:

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Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM1120	**Module Title:** Practical Computer Science 2: Imperative and Object-Oriented Programming		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes		
Content	Modelling of data, class concept, composition and union of class references, class hierarchies, object-oriented modelling and programming, methods and parameter-passing, encapsulation of data, abstract classes, visibility and access rights, imperative methods, GUI programming, debugging		
Objectives	Students know methods and tools of object-oriented modelling and programming and can use them appropriately. They know the characteristics of stateful programming and understand the necessity of encapsulating the state of objects. Students are able to implement and test basic computer science algorithms and data structures using imperative and object-orientated programming methods. In addition, students can effectively localise and eliminate errors in programs. They are prepared to use their programming skills effectively in subsequent larger projects.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Practical Computer Science 2: Imperative and Object-Oriented Progr.	L	o	4	6	yes	wr.	90	g	100
	E	o	2	3					

Transfer	-
Prerequisites	There are no participation requirements.
Responsible Persons	Torsten Grust

Abbreviations:

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Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: INFM2010	**Module Title:** Mathematics for Computer Science 3: Advanced Topics		**Type of Module:** Compulsory Module
ECTS-Points	9		
Workload - Time in Class - Self-Study	Workload: 270 h	Time in Class: 90 h	Self-Study: 180 h
Duration	1 Semester		
Frequency	regularly in Winter Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	Lecture, exercise classes		
Content	Topics include multidimensional analysis, Fourier series, optimisation (extreme value problems under constraints, Lagrange multipliers, algorithms in discrete and continuous optimisation), topics from discrete mathematics such as number theory with applications in cryptology.		
Objectives	Students acquire knowledge of multidimensional analysis, number theory and their application in cryptology and optimisation. After completing this module, students are able to establish links between different mathematical sub-areas and name their significance for computer science.		

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Mathematics for Computer Science 3: Advanced Topics	L	o	4	6	yes	wr.	120	g	100
	E	o	2	3					

Transfer	-
Prerequisites	INFM1010 Mathematics for Computer Science 1 and INFM1020 Mathematics for Computer Science 2 are recommended
Responsible Persons	Britta Dorn, Stephan Eckstein

Abbreviations:

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Examination Type : MT=master's thesis, or.=oral exam, wr.=written exam, Pr=presentation, E=essay, P=portfolio, T=continous assessment tests

Teaching Format : L=lecture, LE=lecture with integrated exercises, SL=seminar or lecture, E=exercise class, T=revision course, P=practical course, PS=introductory seminar, IC=inverted classroom

Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

Module Number: **MAT-10-10**	**Module Title:** Foundations of Mathematics		**Type of Module:** Compulsory Module
ECTS-Points	27		
Workload **- Time in Class** **- Self-Study**	Workload: 810 h	Time in Class: 300 h	Self-Study: 510 h
Duration	2 Semester		
Frequency	every Semester		
Term	-		
Language of Instruction	German		
Forms of Teaching and Learning	1. Semester: Foundations of Mathematics 1, Lecture 6 SWS + Ex.cl. 3 SWS + Rev.c. 2 SWS 2. Semester: Foundations of Mathematics 2, Lecture 6 SWS + Ex.cl. 3 SWS + Rev.c. 2 SWS 1. Semester: Exploring Mathematics, Practical course 2 SWS		
Higher Objectives	In the Foundations of Mathematics module, students learn the essential conceptual and methodological foundations of linear algebra as well as single-variable and multivariable calculus, exploring their interconnections with particular emphasis on the similarities and differences in their approaches. In the oral exam, students demonstrate that they have recognised these relationships and are capable of contextualising the core results of the lectures within these frameworks. The duration of the module supports these objectives while also accounting for the acquisition of a new language - the language of mathematics - and the development of a precise and rigorously logical working methodology. This provides students with the necessary time to make the significant transition from school-level mathematics to university-level mathematics. By demonstrating a deeper and more integrated understanding in the oral exams, students establish a strong foundation for successful participation in all subsequent modules in their academic programme.		

Content	• Basic logic and sets. • Structure of real and complex numbers. • Sequences, convergence and series; criteria for convergence; power series, sequences of functions; pointwise and uniform covergence. • Continous functions in one dimension and between metric spaces and their properties. • One- and multidimensional differential calculus (especially: intermediate value theorem, Taylor expansion, implicit function theorem, inverse function theorem, extrema under constraints). • Onedimensional Riemann integral. • Basic concepts of topology in metric and normed spaces. • Vector spaces and linear maps. • Matrices and systems of linear equations. • Determinants, eigenvalues and diagonalisability. • Jordan canonical form. • Euclidean and unitary vector spaces, spectral theorems. • Basics of analytical geometry. • The lecture Foundations of Mathematics 1 focuses primarily on topics in one-dimensional analysis and introduces basic concepts of linear algebra up to systems of linear equations. The lecture Foundations of Mathematics 2 covers further aspects of linear algebra as well as multivariable analysis. • The submodule Exploring Mathematics serves as an introduction to mathematical working methods, mathematical modelling, and abstraction.
Objectives	The students are familiar with and understand the fundamental concepts, statements, and methods of single-variable and multivariable calculus as well as linear algebra. Their capacity for abstraction has been enhanced, they have been trained in analytical thinking, and their mathematical imagination has been stimulated. Through a proof- and structure-oriented approach, they have learned to comprehend mathematical proofs in calculus and linear algebra and to independently prove or disprove mathematical statements in simple examples. They have recognised the essential relationships within the theory of single-variable and multivariable calculus, their similarities and differences, as well as their connections to linear algebra, and are able to contextualise the core results of the lectures within these frameworks. Students are in principle able to derive a mathematical problem and approaches to its solution from a question that may not be formulated in mathematical terms by means of mathematical modelling, and to relate these back to the original question. In the exercises, they have developed a confident, precise, and independent approach to the concepts, statements, and methods covered in the lectures. Additionally, their presentation and communication skills have been cultivated through written assignments and presenting their own solutions. The students are capable of acquiring knowledge through self-study, while their teamwork abilities have been fostered through collaboration in small groups.

Requirements for obtaining Credits / Grading (Weighting if applicable)

Title	Type of Course	Status	SWS	ECTS	Coursework	Type of Exam	Dur. of Exam (min)	Grading	Weight for Grade
Foundations of Mathematics 1	L	o	6	9	yes	or.	30-40	g	100
	E	o	3	4					
	T	o	2	0					
Foundations of Mathematics 2	L	o	6	9	yes				
	E	o	3	4					
	T	o	2	0					
Exploring Mathematics	P	o	2	1	yes				

In each of the two submodules Foundations of Mathematics 1 and 2, an exercise certificate is required as course work. The exercise certificate is awarded on the basis of regular participation in the exercises together with successful completion of a test related to the exercises. Both components must be completed within the same semester. In the submodule Exploring Mathematics, a practical certificate is required as course work and is obtained through regular active participation.
The assessment of the module takes the form of an oral examination covering the submodules Foundations of Mathematics 1 and 2. Admission to the oral examination requires at least one of the two exercise certificates in the submodules Foundations of Mathematics 1 or 2. The module is deemed completed only once both exercise certificates and the practical certificate have been obtained and the oral examination has been passed.
For modules extending over several semesters, it is strongly recommended to review the content of each submodule thoroughly during the lecture-free periods, thereby spreading the preparation for the oral examination over a longer period of time.

Literature

Possible References :

- Anton Deitmar: Analysis. Springer 2016.
- Otto Forster: Analysis 1. Springer Spektrum 2013.
- Otto Forster: Analysis 2. Vieweg+Teubner 2011.
- Theodor Bröcker: Lineare Algebra und analytische Geometrie. Birkhäuser 2013.
- Gerd Fischer: Lineare Algebra. Springer Spektrum 2014.
- Daniel Grieser: Mathematisches Problemlösen und Beweisen. Springer Spektrum 2017.

Transfer

Depending on the combination of subjects, this is an admission requirement that can be issued as a condition if necessary.

Prerequisites

There are no prerequisites.

Responsible Persons

Daniele Agostini, Anton Deitmar, Frank Loose, Hannah Markwig, Thomas Markwig, Stefan Teufel

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Status : o=obligatory, f=facultative
Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MP1</td><td colspan="2">Module Title:
Mathematics for Physicists 1</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td>Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regelmäßig Wintersemester</td></tr>
<tr><td>Term</td><td colspan="3">-</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture 4 SWS + Ex.cl. 2 SWS</td></tr>
<tr><td>Content</td><td colspan="3">

Foundations

Basic logic and sets.
Structure of real and complex numbers.

One-dimensional Analysis

Sequences, convergence and series; criteria for convergence; power series, sequences of functions; pointwise and uniform covergence.
Continous functions and their properties.
Differential calculus (in particular intermediate value theorem, Taylor expansion).
Riemann integral.

Linear Algebra

Vector spaces and linear maps.
Matrices and systems of linear equations.

</td></tr>
<tr><td>Objectives</td><td colspan="3">Students know and understand the basic concepts, statements and methods of one-dimensional analysis and of linear algebra that are relevant to the study of physics. Their ability to abstract has been promoted and they have been trained in analytical thinking. Using a structure-orientated approach, they have learned to classify physically relevant mathematical statements, to understand mathematical proofs and to independently prove or disprove mathematical statements using simple examples. They have recognised the essential connections of the theory of one-dimensional analysis and linear algebra and are able to classify the central statements of the lectures in these connections.
In the exercises, they have developed a confident, precise and independent handling of the concepts, statements and methods from the lectures. In addition, the students' presentation and communication skills were trained through written work and presenting their own solutions. The students are able to acquire knowledge through self-study and at the same time their ability to work in a team was promoted by working in smaller groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Mathematics for Physicists 1</td><td>L</td><td>o</td><td>4</td><td>6</td><td rowspan="2">yes</td><td rowspan="2">wr.</td><td rowspan="2">90-180</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>2</td><td>3</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired.
</td></tr>
</table>

Transfer	Mathematics for physicists on the Bachelor's degree programme in Physics
Prerequisites	none
Responsible Persons	The dean of studies at the Department of Mathematics

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Status : o=obligatory, f=facultative

Other : h=hours, o.=or, s.M.=see module description, SWS=contact hours per week

<table>
<tr><td>Module Number:
MP2</td><td colspan="2">Module Title:
Mathematics for Physicists 2</td><td>Type of Module:
Compulsory Module</td></tr>
<tr><td>ECTS-Points</td><td colspan="3">9</td></tr>
<tr><td>Workload
- Time in Class
- Self-Study</td><td>Workload:
270 h</td><td>Time in Class:
90 h</td><td>Self-Study:
180 h</td></tr>
<tr><td>Duration</td><td colspan="3">1 Semester</td></tr>
<tr><td>Frequency</td><td colspan="3">regelmäßig Sommersemester</td></tr>
<tr><td>Term</td><td colspan="3">-</td></tr>
<tr><td>Language of Instruction</td><td colspan="3">German</td></tr>
<tr><td>Forms of Teaching and Learning</td><td colspan="3">Lecture 4 SWS + Ex.cl. 2 SWS</td></tr>
<tr><td>Content</td><td colspan="3">• Linear Algebra
– Determinants, eigenvalues, diagonalisability, normal forms.
– Euclidean and unitary vector spaces; spectral theorems.
• Multivariable Analysis
– Sequences and convergence in several variables.
– Continuity of functions in several variables.
– Differential calculus in several variables (in particular Taylor expansion, extrema, the Implicit Function Theorem, constrained extrema).</td></tr>
<tr><td>Objectives</td><td colspan="3">Students know and understand the fundamental concepts, statements and methods of linear algebra and multivariable analysis in $\mathbb{R}^n$, up to and including differential calculus. Their ability to abstract has been promoted and they have been trained in analytical thinking. Using a structure-orientated approach, they have learned to classify physically relevant mathematical statements, to understand mathematical proofs and to independently prove or disprove mathematical statements using simple examples. They have recognised the essential connections of the theory of linear algebra and multi-dimensional analysis and are able to classify the central statements of the lectures in these connections.
In the exercises, they have developed a confident and independent handling of the concepts and computing methods from the lectures. In addition, the students' presentation and communication skills were trained through written work and presenting their own solutions. At the same time their ability to work in a team was promoted by working in smaller groups.</td></tr>
<tr><td>Requirements for obtaining Credits / Grading (Weighting if applicable)</td><td colspan="3">
<table>
<tr><th>Title</th><th>Type of Course</th><th>Status</th><th>SWS</th><th>ECTS</th><th>Coursework</th><th>Type of Exam</th><th>Dur. of Exam (min)</th><th>Grading</th><th>Weight for Grade</th></tr>
<tr><td rowspan="2">Mathematics for Physicists 2</td><td>L</td><td>o</td><td>4</td><td>6</td><td rowspan="2">yes</td><td rowspan="2">wr.</td><td rowspan="2">90-180</td><td rowspan="2">g</td><td rowspan="2">100</td></tr>
<tr><td>E</td><td>o</td><td>2</td><td>3</td></tr>
</table>
In this module an exercise certificate is to be acquired as coursework. For participation in the examination the coursework must have been acquired.</td></tr>
<tr><td>Transfer</td><td colspan="3">Mathematics for physicists on the Bachelor's degree programme in Physics</td></tr>
<tr><td>Prerequisites</td><td colspan="3">none</td></tr>
<tr><td>Responsible Persons</td><td colspan="3">The dean of studies at the Department of Mathematics</td></tr>
</table>

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