These degree program and examination regulations have been worded carefully to be up to date; however, errors cannot be completely excluded. The official German text available at the Examinations Office is the version that is legally binding.

Note: Students who started their studies before the latest amendment came into effect are requested to also comply with previous amendments and the respective transitory provisions.

Degree program and examination regulations for the Bachelor's degree program in Industrial Mathematics and the Master's degree program in Computational and Applied Mathematics at the Faculty of Sciences at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) – FPOTechnoMathe –

Dated March 11, 2015

amended by statutes of
February 27, 2017
July 15, 2019
August 20, 2020

Based on Section 13 (1)(2), Section 43 (5)(2), Section 58 (1) and Section 61 (2)(1) of the Bavarian Higher Education Act (Bayerisches Hochschulgesetz, **BayHSchG**), FAU enacts the following degree program and examination regulations:

Table of contents

Part I: General Provisions

Section 37 Scope

The degree program and examination regulations for the Bachelor's degree program in Industrial Mathematics and the Master's degree program in Computational and Applied Mathematics supplements the current version of the general degree program and examination regulations for the Bachelor's and Master's degree programs in Data Science, Mathematics, Industrial Mathematics and Economics and Mathematics as well as the Master's degree programs in Data Science, Mathematics, Computational and Applied Mathematics and Economics and Mathematics at the Faculty of Sciences at FAU (**ABMPOMathe/NatFak**).

Section 38 Bachelor's Degree Program, Standard Duration of Studies, Related Degree Programs

[1]The Bachelor's degree program in Industrial Mathematics consists of modules worth 180 ECTS credits distributed over six semesters. [2]This includes the period for working on the Bachelor's thesis.

(2) Bachelor's degree programs in mathematical sciences count as related degree programs within the meaning of Section 26 (1)(2)(2) **ABMPOMathe/NatFak**, provided at least 125 ECTS credits are allocated to mathematics in the curriculum of the degree program, and 20 ECTS credits are included from engineering and 20 ECTS credits from computer sciences.

Section 39 Master's Degree Program, Teaching and Examination Language

(1) [1]The Master's degree program in Computational and Applied Mathematics builds on Bachelor's degree programs in Mathematics. [2]It consists of modules worth 120 ECTS credits including the Master's thesis, distributed over four semesters.

(2) [1]Notwithstanding Section 4 (5) **ABMPO/TechFak**, the teaching and examination language is English. [2]Individual modules may be taught and assessed in German. [3]This shall not affect Section 4 (5) **ABMPO/NatFak**.

Part II: Special Provisions

1. Bachelor's Examination

Section 40 Structure of the Bachelor's Degree Program

[1]The Bachelor's degree program consists of:
a) Compulsory modules in industrial mathematics (nos. 1 to 7, 9, 14, 18 and 19),
b) Compulsory elective modules in mathematics (no. 8 pursuant to Section 42),
c) Compulsory elective modules in the minor subject computer science (nos. 10 to 12 pursuant to Section 43),
d) Compulsory elective modules in the technical elective subject (no. 13 pursuant to Section 44),
e) Key qualifications (no. 15 pursuant to Section 45),
f) Compulsory modules interdisciplinary module and seminar (nos. 16 and 17 pursuant to Section 46).
[2]Details are set forth hereinafter and in **Appendix 1**.

Section 41 Grundlagen- und Orientierungsprüfung (GOP)

In order to pass the preliminary examination (Grundlagen- und Orientierungsprüfung (**GOP**)), students must obtain at least 30 ECTS credits from the foundation modules Analysis I, Analysis II, Analysis III, Linear algebra I and Linear algebra II.

Section 42 Compulsory Elective Modules in Mathematics

(1) [1]The compulsory elective modules in mathematics (no. 8 pursuant to **Appendix 1b**) account for 30 ECTS credits. [2]The learning outcome of the compulsory elective modules in mathematics is to allow students to gain a more in-depth knowledge of selected skills relating to industrial mathematics. [3]The second learning outcome has a research focus, with students learning subject-related methods of research and exploring their subject in more depth. [4]Thirdly, the element of choice allows students to tailor their profile in view of their career plans.

(1) [1]Students choose a compulsory elective module in mathematics by registering for the first examination in a module from the group of compulsory elective modules in mathematics. [2]The compulsory elective modules in mathematics are listed in a module catalog, which is announced in accordance with local practice at the latest one week before the semester starts. [3]Changes to the module catalog can be made by the Examinations Committee, to take effect from the following semester.

(3) [1]The type and scope of the examination and the way in which the grade is determined for compulsory elective modules in mathematics depend on the specific manner in which the respective module is taught; see module handbook for details. [2]Possible examination achievements for compulsory elective modules in mathematics are as follows:
1. Written examination (60–120 min)
2. Written assignment (approx. 5–10 pages)
3. Report (approx. 5–10 pages)
4. Oral examination (15–30 min.)
5. Online examination (e-examination 30-60 min)
6. Tutorial achievement (approx. 30–45 pages)
7. Practical achievement (report approx. 5–10 pages or series of reports approx. 40 pages)

8. Seminar achievement (presentation 30–80 min.), possibly with written assignment (approx. 5–10 pages)
9. Excursion achievement (report approx. 5–10 pages or series of reports approx. 30–45 pages)
and combinations of the above. [3]In particular in the cases covered by Section 6 (2)(3) **ABMPOMathe/NatFak**, it is possible to combine a written or oral examination with achievements as set forth in Section 6 (4) **ABMPOMathe/NatFak**. [4]Further details are stipulated in the module handbook.

(2) [1]Modules amounting to 5 ECTS credits usually consist of lectures (2 SWS) and tutorials (up to 2 SWS) or seminars (2 SWS). [2]Modules amounting to 10 ECTS credits usually consist of lectures (4 SWS) and tutorials (up to 3 SWS). [3]Any exceptions are detailed in the module handbook.

Section 43 Compulsory Elective Modules in the Minor Subject Computer Science

(1) [1]The minor subject computer science consists of the compulsory module no. 9 and the compulsory elective modules nos. 10 to 12 pursuant to **Appendix 1b**. [2]One of the compulsory elective modules no. 10 or no. 11 must be selected. [2]The minor subject computer science accounts for 20 to 25 ECTS credits. [3]A total of 45 ECTS credits shall be awarded for the minor subject computer science together with the elective technical module (see Section 44).

(2) Section 42 (2) shall apply accordingly with respect to registering for the examination.

(3) The type and scope of teaching units and the examination in the compulsory elective modules in the minor subject computer science depend on the specific manner in which the respective module is taught, see the degree program and examination regulations for the Bachelor's and Master's degree programs in computer science at the Faculty of Engineering – **FPOINF** – or the module handbook for details.

Section 44 Compulsory Elective Modules in the Technical Elective

(1) [1]Compulsory elective modules in the technical elective are module packets from the following:
1. Chemical and Biological Engineering (CBI),
2. Electrical, Electronic and Communication Engineering (EEI),
3. Mechanical Engineering,
4. Medical Engineering.

[2]The technical elective accounts for 20 to 25 ECTS credits. [3]A total of 45 ECTS credits shall be awarded for the minor subject computer science together with the elective technical module (see Section 43).

(2) Section 42 (2) and Section 43 (3) shall apply accordingly with respect to registering for the examination and the type and scope of teaching units.

Section 45 Key Qualifications

(1) [1]The key qualifications consist of the compulsory module no. 14 and the compulsory elective module no. 15 pursuant to **Appendix 1b**. [2]Key qualifications can be chosen from the 'key qualifications' offered by FAU. [3]Taking part in a training course for tutors followed by two semesters as a tutor at the Department of Mathematics and completing

an industrial internship of (at least) four weeks approved by the Examinations Committee may also be counted as key qualifications worth 5 ECTS credits each.

(2) Students choose key qualification modules by registering for the first examination in the relevant module or by registering for the training course or internship.

(3) [1]The type and scope of teaching units and the examination in modules from the Department of Mathematics are stipulated in Section 42 (3) and (4) respectively. [2]The type and scope of teaching units and examinations depend on the specific manner in which the respective module is taught and are regulated by the applicable **(degree program and) examination regulations** and/or the module handbook.

Section 46 Interdisciplinary Module and Seminar

(1) [1]The learning outcome of the interdisciplinary module and the seminar module (nos. 16 and 17 pursuant to **Appendix 1b**) is to allow students to gather, analyze and interpret information relevant to their subject. [2]A second learning outcome is aimed at promoting personal and social skills through preparing, reporting on and presenting a topic relating to the subject for a specialist audience at a Bachelor's level and in a manner tailored to suit the target group, as well as working under supervision in a group to develop and test subject-related applications and possibilities for implementation with respect to the chosen subject. [3]Thirdly, the element of choice allows students to tailor their profile in view of their career plans.

(2) Section 42 (2) to (4) shall apply accordingly with respect to registering for examinations and the type and scope of teaching units.

Section 47 Bachelor's Seminar and Bachelor's Thesis

[1]Specialist knowledge and skills relating to one specialist area of industrial mathematics are acquired during a Bachelor's seminar worth 5 ECTS credits. [2]The subject of this Bachelor's seminar can be taken as the basis for a Bachelor's thesis, which is generally supervised by the person responsible for teaching the Bachelor's seminar. [3]A prerequisite for participating in a Bachelor's seminar is that the interdisciplinary module (no. 16 pursuant to **Appendix 1b**) has been successfully completed.

2. Master's Examination

Section 48 Qualification for a Master's Degree, Certificates and Admission Requirements

(1) [1]A subject-specific degree within the meaning of Section 31 (1)(1)(1) **ABMPOMathe/NatFak** is a Bachelor's degree or a Diplom degree in the subject mathematics, industrial mathematics or economics and mathematics. [2]In particular, Bachelor's degrees in physics, engineering or computer science that cover mathematical topics accounting for at least 45 ECTS credits shall be recognized as subject-related degrees within the meaning of Section 31 (1)(1)(1) **ABMPOMathe/NatFak**. [3]Applicants with a subject-related degree shall only be admitted to the Master's degree program after passing an oral admission examination pursuant to Section 5 (4) of the **Appendix ABMPOMathe/NatFak**.

(2) [1]Additional proof that must be submitted as stipulated in Section 2 (2)(3) of the **Appendix to ABMPOMathe/NatFak** shall be proof of language proficiency of at least English Level B 2 (Common European Framework of Reference for Languages – **CEFR**) Vantage or Upper Intermediate. Evidence of this can be provided, in particular, by having participated in English lessons for 6 years at a German grammar school (Gymnasium). [2]Applicants who have completed their university entrance qualifications or their first degree in English are not required to provide proof of proficiency in English.

(3) In the oral admission examination according to Section 5 (3) et seq. of the **Appendix** to **ABMPOMathe/NatFak**, applicants shall be evaluated according to the following criteria:

1. Quality of basic knowledge in function analysis or theory of differential equations (35%),
2. Quality of basic knowledge in numerical analysis or optimization (35%),
3. Ability to discuss mathematical topics in English, e.g. the content of their Bachelor's thesis (30%).

Section 49 Scope and Structure of the Master's Degree Program, Specializations

(1) [1]The Master's degree program consists of compulsory modules, the compulsory elective modules in the chosen specialization pursuant to (2), the free electives and the Master's seminar and the Master's thesis. [2]Details are set forth hereinafter and in **Appendix 2**.

(2) [1]The Master's degree program in Computational and Applied Mathematics comprises modules from the following areas of specialization:

- Modeling and applied analysis (MApA),
- Numerical Analysis and Simulation (NASi),
- Optimization (Opti),
- High performance computing (HPC)

worth at least 105 ECTS credits and free electives offered by FAU at Master's level worth a maximum of 15 ECTS credits. [2]The Master's degree program is offered in three areas of specialization:

- MApA and NASi
- MApA and Opti
- NASi and Opti.

[3]Applicants state their chosen specialization in their application for admission to the Master's degree program, but this can be changed over the course of the degree program.

(3) [1]The Master's degree program includes the modules set forth in **Appendix 2**. [2]A total of 120 ECTS credits must be obtained during the Master's degree program in accordance with the following requirements:

1. 35 ECTS credits from compulsory modules pursuant to **Appendix 2b to 2d,**
2. 30 ECTS credits from Master's seminar and Master's thesis pursuant to **Appendix 2b to 2d,**
3. 40 ECTS credits from compulsory elective modules from the specializations MApA, NASi and Opti pursuant to **Appendix 2b to 2d**,
4. 15 ECTS credits from all courses offered at FAU for Master's degree programs (free elective module pursuant to Section 51).

[3]At least 65 ECTS credits from the modules named in sentence 2 must be allocated to the chosen specialization.

(4) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 50 Compulsory Elective Modules in Specialization Areas

(1) [1]In the compulsory elective modules, students acquire skills in scientific methods for classifying mathematical structures, for modeling and for problem-solving strategies and the ability to carry out academic work independently. [2]The learning outcome has a research focus, with students learning subject-related methods of research and exploring their subject in more depth. [3]The element of choice allows students to tailor their profile in view of their career plans.

(2) The individual areas of specialization pursuant to Section 49 (2) (1) have the following subject-specific learning outcomes:

1. In the MApA area of specialization, students acquire methodological skills which enable them to carry out modeling in natural sciences and engineering as well as to deal in a rigorously mathematical and analytical manner with the resulting partial differential equations or variational problems.
2. In the NASi area of specialization, students acquire methodological skills which enable them to develop, implement and mathematically analyze efficient numerical procedures for modeling in the natural sciences and engineering.
3. In the Opti area of specialization, methodological skills are obtained enabling students to optimize discrete and/or continuous systems.

(3) Section 42 (2) sentences 2 and 3 and Section 42 (3) and (4) shall apply accordingly with respect to registering for the examination and the type and scope of teaching units.

Section 51 Free Elective Modules

[1]Free elective modules worth a total of 15 ECTS credits can be chosen from the entire range of modules offered at FAU. [2]The type and scope of the teaching units and examinations are stipulated accordingly in Section 45 (3).

Section 52 Mentoring and Individual Study Agreement

(1) [1]Each student is assigned a mentor upon commencing the Master's degree program. The mentor is responsible for assisting the student in drawing up an individual study agreement and answering any questions students may have concerning their degree program. [2]This mentoring relationship shall be maintained throughout the Master's degree program. [3]Applicants may suggest a mentor when applying to be admitted to the Master's degree program.

(2) [1]At the beginning of the Master's degree program, the mentor and the student shall work together to draw up an individual study agreement which should take the specific subject areas the student is interested in into account. [2]This study agreement shall remain valid for the duration of the Master's degree program and shall list all the modules which are to be taken. [3]It shall be submitted to the Examinations Office for approval by the date of the first examination in the Master's degree program.

(3) [1]The study agreement may be updated in consultation with the mentor if necessary. [2]The updated version shall be submitted to the Examination Office for approval without delay.

Section 53 Master's Degree Examinations

[revoked]

Section 54 Requirements for Admission to the Master's Thesis

[revoked]

Section 55 Master's Thesis Module

(1) [1]25 ECTS credits shall be awarded for the Master's thesis module. [2]This module shall consist of the Master's thesis (22.5 ECTS credits) and an oral examination, or colloquium (2.5 ECTS credits).

(2) [1]The Master's thesis is intended to demonstrate the student's ability to solve scientific problems in the field of computational and applied mathematics. [2]Requirements for the thesis shall be such that it can completed within a period of six months.

(3) The Master's thesis shall usually deal with a scientific subject from the chosen specialization.

Part III: Final Provisions

Section 56 Legal Validity

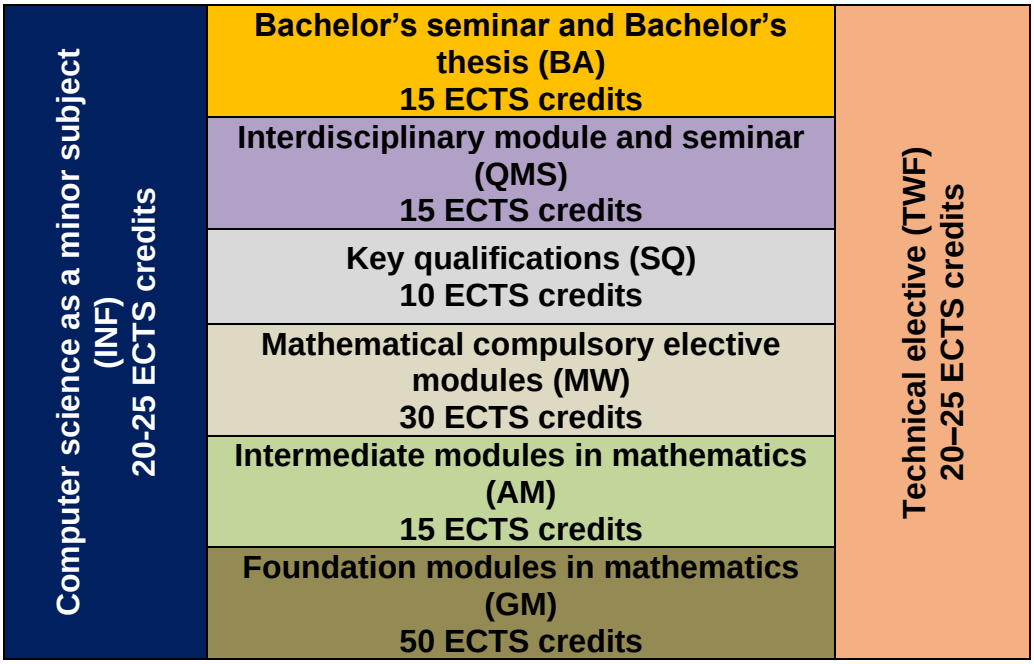
(1) [1]These degree program and examination regulations shall come into effect on the day after their publication. [2]They shall apply to all students who start the Bachelor's or Master's degree program Industrial Mathematics in the winter semester 2015/2016 or later. [3]Students who are already studying under the previous examination regulations for the Bachelor's and Master's degree programs in Mathematics, Industrial Mathematics and Economics and Mathematics from September 7, 2007 in the version dated July 30, 2010 shall sit their examinations according to the previously valid examination regulations.

(2) [1]The second amendment statute shall come into effect on the day after its publication. [2]It shall apply to all students starting a degree program from winter semester 2019/2020 onward. [3]Notwithstanding sentence 2, the changes in Sections 37 to 39 shall also apply to all students who are currently studying under a currently valid version of **FPOTechnoMathe**.

(3) [1]The third amendment statute shall come into effect on October 1, 2020. [2]Notwithstanding 1, the amendments in the Bachelor's degree modules Numerical mathematics (old) and Introduction to numerical analysis (new) shall apply to all students who have not yet started examinations for these modules (initial attempt). [3]Examinations in accordance with previous versions of the degree program and examination regulations will be offered for the last time in winter semester 2024/2025 for the Bachelor's degree program and in winter semester 2023/2024 for the Master's degree program. [4]From the date stated in sentence 3, those students who are affected by the examination regulations becoming invalid shall take their examinations in accordance with the currently valid version of the degree program and examination regulations.

Appendix 1: Bachelor's Degree Program in Industrial Mathematics

Appendix 1a: Overview of Curriculum



The regulations for the colored blocks are explained in detail in Section 40 et seq and the (sample) degree program structure depicted below (see **Appendix 1b**).

Appendix 1b: (Sample) Degree Program Structure for Bachelor's Degree Program in Industrial Mathematics

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination/course achievement	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Foundation modules (GM)	1	Analysis I	Lecture: Analysis I	4					10	6						Written examination 120 min and tutorial achievement (ungraded)	0
			Tutorial: Analysis I		2					2							
			Blackboard exercise: Analysis I		2					2							
	2	Analysis II	Lecture: Analysis II	4					10		6					Written examination 120 min and tutorial achievement (ungraded)	0.5
			Tutorial: Analysis II		2						2						
			Blackboard exercise: Analysis II		2						2						
	3	Analysis III	Lecture: Analysis III	4					10			7				Written examination 120 min and tutorial achievement (ungraded)	1
			Tutorial: Analysis III		2							2					
			Blackboard exercise: Analysis III		1							1					
	4	Linear algebra I	Lecture: Linear algebra I	4					10	6						Written examination 120 min and tutorial achievement (ungraded)	0
			Tutorial: Linear algebra I		2					2							
			Blackboard exercise: Linear algebra I		2					2							
	5	Linear algebra II	Lecture: Linear algebra II	4					10		6					Written examination 120 min and tutorial achievement (ungraded)	0.5
			Tutorial: Linear algebra II		2						2						
			Blackboard exercise: Linear algebra II		2						2						
		Total foundation modules (GM)		**20**	**19**			**0**	**50**	**20**	**20**	**10**	**0**	**0**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination/course achievement	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Intermediate modules (AM)	**6**	Introduction to numerical analysis	Lecture: Introduction to numerical analysis	4					10			7				Written examination 90 min and tutorial achievement (ungraded)	1
			Exercises for Introduction to numerical analysis		2							2					
			Tutorial for Introduction to numerical analysis		1							1					
	7	Mathematical modeling theory	Lecture: Mathematical modeling theory	2					5					3		Oral examination 15 min	1
			Tutorial: Mathematical modeling theory		2									2			
		Total intermediate modules (AM)		**6**	**5**			**0**	**15**	**0**	**0**	**10**	**0**	**5**	**0**		
Mathematical compulsory elective modules (MW)	**8**	Compulsory elective modules from FAU catalog for numerical mathematics, modeling, and optimization pursuant to Section 42	see Section 42 (4)						30				10	7.5	12.5	see Section 42 (3)	1
		Total mathematical compulsory elective modules (MW)							**30**	**0**	**0**		**10**	**7.5**	**12.5**		
Minor subject computer science (INF)	**9**	Algorithms and data structures	see FPO INF						10	10						see FPO INF	0.75
	10	Fundamentals of system programming	see FPO INF	2	2				(5)		(5)					see FPO INF	0.75
	11	Machine-oriented programming in C	see FPO INF	2	2				(5)		(5)					see FPO INF	0.75
	12	Compulsory elective modules from the catalog for the minor subject computer science (INF) pursuant to Section 43	see Section 43 (3)						5–10				5	(5)		see Section 43 (3)	1
		Total computer science as a minor subject (INF)						**0**	**20–25**	**10**	**5**	**0**	**5**	**(5)**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination/course achievement	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Technical elective (TWF)	**13**	Compulsory elective module from catalog for technical elective (TWF) pursuant to Section 44	see Section 44 (2)									10	5	5	(5)	see Section 44 (2)	1
		Total technical elective (TWF)						**0**	**20–25**	**0**	**0**	**10**	**5**	**5**	**(5)**		
Key qualifications (SQ)	**14**	Mathematical modeling practical	Mathematical modeling practical			2			5					5		Presentation (30–40 min, ungraded) and project report (5–10 pages, ungraded)	0
	15	KQ elective module pursuant to Section 45	see Section 45 (3)						5		5					see Section 45 (3)	0
		Total key qualifications (KQ)							**10**	**0**	**5**	**0**	**0**	**5**	**0**		
Interdisciplinary module and seminar (QMS)	**16**	Interdisciplinary module pursuant to Section 46	Lecture: Interdisciplinary module	4					10				7			Oral examination (20 min) and tutorial achievement (ungraded)	1
			Tutorial on interdisciplinary module		2								2				
			Blackboard exercise: Interdisciplinary module		1								1				
	17	Seminar pursuant to Section 46	Intermediate course				2		5					5		Seminar achievement, see Section 46	1
		Total interdisciplinary module and seminar (QMS)							**15**	**0**	**0**	**0**	**10**	**5**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination/course achievement	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Bachelor's seminar and Bachelor's thesis (BA)	**18**	Bachelor's seminar	Bachelor's seminar				2		5						5	Seminar achievement, see Section 6 (4) and (5) **ABMPOMathe/Nat-Fak**	0
	19	Bachelor's thesis							10						10	Bachelor's thesis (approx. 20–25 pages)	1.5
		Total Bachelor's seminar and Bachelor's thesis (BA)							**15**						**15**		
		Total semester hours (at least) [1] and ECTS credits		32	29	0	6	0	**180**	30	30	30	30	27.5–32.5	27.5–32.5		

[1] The classes for the mathematical compulsory elective module, the minor subject computer science, the technical elective and the key qualification are added to the total.

Key:
Tutorial achievement: see Section 6 (4) **ABMPOMathe/NatFak**.

Appendix 2: Master's Degree Program in Computational and Applied Mathematics

Appendix 2a: Overview of Curriculum

<table>
<tr><td rowspan="2">Free elective modules (WM)

15 ECTS credits</td><td>Master's seminar and Master's thesis (MA)

30 ECTS credits</td><td rowspan="2">Compulsory elective modules
(WP)

40 ECTS credits</td></tr>
<tr><td>Compulsory modules
(PM)

35 ECTS credits</td></tr>
</table>

[1]The regulations for the colored blocks are explained in detail in Section 49 and in **Appendices 2b to 2d**.
The regulations for the colored blocks are explained in detail in the (sample) degree program structure depicted below (see **Appendices 2b to 2d**). [2]One of the following specializations is chosen at the beginning of the Master's degree program within the framework of an individual study agreement:

- MApA and NASi
- MApA and Opti
- NASi and Opti

Further information is given in Section 49.
[3]The detailed degree program structure is discussed with the mentor when the student starts studying the Master's degree program and set down in an individual study agreement (see Section 52).

Appendix 2b: Degree Program Structure for the Master's Degree Program in Computational and Applied Mathematics – Specialization MApA und NASi **–**

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination/ course achievements	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory modules (PM)	1	MApA	**Modeling and analysis in continuum mechanics I**	Modeling and analysis in continuum mechanics I	4				**10**	8^1	8^2			Oral examination (20 min)	1
				Tutorials on Part I		1				2^1	2^2				
	2	MApA	**Modeling and analysis in continuum mechanics II**	Modeling and analysis in continuum mechanics II	2				**5**		4^1	4^2		Oral examination (20 min)	1
				Tutorials on Part II		1/2					1^1	1^2			
	3	MApA/ NASi/ Opti	**Modeling, simulation and optimization**	Practical course: Modeling, simulation and optimization				3	**5**		5^1	5^2		Presentation (approx 45 min, 50%) with final report (approx. 10 pages, 50%)	1
	4	HPC	**Programming techniques for supercomputers in CAM**	Programming techniques for supercomputers	4				**10**	5^2	5^1			see FPO INF	1
				Tutorials: Programming techniques for supercomputers		2				5^2	5^1				
	5	HPC	**Architectures of supercomputers**	Architectures of supercomputers	2				**5**		2.5^2	2.5^1		see FPO INF	1
				Tutorials on architectures of supercomputers		2					2.5^2	2.5^1			
		Total compulsory modules (PM)			12	5.5	0	3	**35**	$10^{1.2}$	20^1 15^2	5^1 10^2	$0^{1.2}$		

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination/ course achievements	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory elective modules (WP)	6	MApA/NASi	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3).	see Section 50 (3)					**15–40**[3]	10[1] 5[2]	5–10[1] 10–15[2]	0–20[1] 0–15[2]	0[1] 0–5[2]	see Section 50 (3)	1
	7	MApA/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3).	see Section 50 (3)					**0–25**[3]	0[1.2]	0–5[1.2]	0–20[1] 0–15[2]	0[1] 0–5[2]	see Section 50 (3)	1
	8	Nasi/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**0–25**[3]	0[1.2]	0–5[1.2]	0–20[1] 0–15[2]	0[1] 0–5[2]	see Section 50 (3)	1
		Total compulsory elective modules (WP)							**40**	10[1] 5[2]	10[1] 15[2]	20[1] 15[2]	0[1] 5[2]		

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination/ course achievements	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Free elective modules (WM)	9		Free elective modules	see Section 51					**15**	10[1] 15[2]			5[1] 0[2]	see Section 51	1
		Total free elective modules (WM) pursuant to Section 49 (3)(2)(4)							**15**	10[1] 15[2]	0[1.2]	0[1.2]	5[1] 0[2]		
Master' s seminar and Master' s thesis (MA)	10a	MApA	**Master's seminar MApA**	Master's seminar MApA				2	**5**			(5)		Seminar achievement[4]	1
	10b	NASi	**Master's seminar NASi**	Master's seminar NASi				2				(5)		Seminar achievement[4]	1
	10c	Opti	**Master's seminar Opti**	Master's seminar Opti				2				(5)		Seminar achievement[4]	1
	11	MApA/ NASi/ Opti	**Master's thesis**	Master's colloquium					**25**				2.5	Oral examination (15 min) (10%) with Master's thesis (90%)	1
				Master's thesis									22.5		
		Total Master's seminar and Master's thesis (MA)			0	0	0	2	**30**	0	0	5	25		

[1] Students starting to study in the winter semester.
[2] Students starting to study in the summer semester.
[3] The ECTS credits are obtained by completing compulsory MApA modules worth 15 ECTS credits (compulsory modules) and the practical course (compulsory module), Master's seminar and Master's thesis in MApA or NASi.
[4] The seminar achievement consists of a presentation (70–80 min) and a presentation handout (5–10 pages).

Appendix 2c: Degree Program Structure for the Master's Degree Program in Computational and Applied Mathematics – **Specialization** MApA and Opti –

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination course achievements	Grade factor grade
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory modules (PM)	1	MApA	**Modeling and analysis in continuum mechanics I**	Modeling and analysis in continuum mechanics I	4				**10**	8^1	8^2			Oral examination (20 min)	1
				Tutorials on Part I		1				2^1	2^2				
	2	MApA	**Modeling and analysis in continuum mechanics II**	Modeling and analysis in continuum mechanics II	2				**5**		4^1	4^2		Oral examination (20 min)	1
				Tutorials on Part II		1/2					1^1	1^2			
	3	MApA/ NASi/ Opti	**Modeling, simulation and optimization**	Practical course: Modeling, simulation and optimization				3	**5**		5^1	5^2		Presentation (approx 45 min, 50%) with final report (approx. 10 pages, 50%)	1
	4	HPC	**Programming techniques for supercomputers in CAM**	Programming techniques for supercomputers in CAM	4				**10**	5^2	5^1			see FPO INF	1
				Tutorials: Programming techniques for supercomputers		2				5^2	5^1				
	5	HPC	**Architectures of supercomputers**	Architectures of supercomputers	2				**5**		2.5^2	2.5^1		see FPO INF	1
				Tutorials on architectures of supercomputers		2					2.5^2	2.5^1			
		Total compulsory modules (PM)			12	5.5	0	3	**35**	$10^{1.2}$	20^1 15^2	5^1 10^2	$0^{1.2}$		

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination course achievements	Grade factor grade
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory elective modules (WP)	6	MApA/NASi	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**0-25[3]**	0[1,2]	0-5[1,2]	0-20[1] 0-15[2]	0[1] 0-5[2]	see Section 50 (3)	1
	7	MApA/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**15–40[3]**	10[1] 5[2]	5–10[1] 10–15[2]	0–20[1] 0–15[2]	0[1] 0–5[2]	see Section 50 (3)	1
	8	Nasi/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**0–25[3]**	0[1,2]	0–5[1,2]	0–20[1] 0–15[2]	0[1] 0–5[2]	see Section 50 (3)	1
		Total compulsory elective modules (WP)							**40**	10[1] 5[2]	10[1] 15[2]	20[1] 15[2]	0[1] 5[2]		

	No.	Area of specialization	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination course achievements	Grade factor grade
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Free elective modules (WM)	9		Free elective modules	see Section 51					**15**	10[1] 15[2]			5[1] 0[2]	see Section 51	1
		Total free elective modules (WM) pursuant to Section 49 (3)(2)(4)							**15**	10[1] 15[2]	0[1.2]	0[1.2]	5[1] 0[2]		
Master' s seminar and Master' s thesis (MA)	10a	MApA	**Master's seminar MApA**	Master's seminar MApA				(2)	**5**			(5)		Seminar achievement[4]	1
	10b	NASi	**Master's seminar NASi**	Master's seminar NASi				(2)				(5)		Seminar achievement[4]	1
	10c	Opti	**Master's seminar Opti**	Master's seminar Opti				(2)				(5)		Seminar achievement[4]	1
	11	MApA/ NASi/ Opti	**Master's thesis**	Master's colloquium					**25**				2.5	Oral examination (15 min) (10%) with Master's thesis (90%)	1
				Master's thesis									22.5		
		Total Master's seminar and Master's thesis (MA)			0	0	0	2	**30**	0	0	5	25		

[1] Students starting to study in the winter semester.
[2] Students starting to study in the summer semester.
[3] The ECTS credits are obtained by completing compulsory MApA modules worth 15 ECTS credits (compulsory modules) and the practical course (compulsory module), Master's seminar and Master's thesis in MApA or Opti.
[4] The seminar achievement consists of a presentation (70–80 min) and a presentation handout (5–10 pages).

Appendix 2d: Degree Program Structure for the Master's Degree Program in Computational and Applied Mathematics – Specialization NASi and Opti –

	No.	Spezialisierungsgebiet	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination/ course achievements	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory modules (PM)	1	MApA	**Modeling and analysis in continuum mechanics I**	Modeling and analysis in continuum mechanics I	4				**10**	8^1	8^2			Oral examination (20 min)	1
				Tutorials to Part I		1				2^1	2^2				
	2	MApA	**Modeling and analysis in continuum mechanics II**	Modeling and analysis in continuum mechanics II	2				**5**		4^1	4^2		Oral examination (20 min)	1
				Tutorials on Part II		1/2					1^1	1^2			
	3	MApA/ NASi/ Opti	**Modeling, simulation and optimization**	Practical course: Modeling, simulation and optimization				3	**5**		5^1	5^2		Presentation (approx 45 min, 50%) with final report (approx. 10 pages, 50%)	1
	4	HPC	**Programming techniques for supercomputers for CAM**	Programming techniques for supercomputers	4				**10**	5^2	5^1			see FPO INF	1
				Tutorials: Programming techniques for supercomputers		2				5^2	5^1				
	5	HPC	**architectures of supercomputers**	Architectures of supercomputers	2				**5**		2.5^2	2.5^1		see FPO INF	1
				Tutorials on architectures of supercomputers		2					2.5^2	2.5^1			
		Total compulsory modules (PM)			12	5.5	0	3	**35**	$10^{1.2}$	20^1 15^2	5^1 10^2	$0^{1.2}$		

	No.	Spezialisier-ungs-gebiet	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semester in ECTS credits				Type and scope of the examination/ course achievements	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Compulsory elective modules (WP)	6	MApA/NASi	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**0–10[3]**	0[1.2]	0[1] 0–10[2]	0–10[1] 0[2]	0[1.2]	vgl. § 50 Abs. 3	1
	7	MApA/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**0–10[3]**	0[1.2]	0[1] 0–10[2]	0–10[1] 0[2]	0[1.2]	see Section 50 (3)	1
	8	Nasi/Opti	Compulsory elective modules from catalog depending on chosen specialization pursuant to Section 49 (2)(3)	see Section 50 (3)					**30–40[3]**	10[1] 5[2]	10[1] 5–15[2]	10–20[1] 15[2]	0[1] 5[2]	see Section 50 (3)	1
		Total compulsory elective modules (WP)							**40**	10[1] 5[2]	10[1] 15[2]	20[1] 15[2]	0[1] 5[2]		

	No.	Spezialisier-ungs-gebiet	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Distribution of workload per semes-ter in ECTS credits				Type and scope of the examination/ course achieve-ments	Grade factor
					L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Free elective modules (WM)	9		Free elective modules	see Section 51					**15**	10[1] 15[2]			5[1]	see Section 51	1
		Total free elective modules (WM) pursuant to Section 49 (3)(2)(4)							**15**	10[1] 15[2]	0[1.2]	0[1.2]	5[1] 0[2]		
Master's seminar and Master's thesis (MA)	10a	MApA	Master's seminar MApA	Master's seminar MApA				(2)	**5**			(5)		Seminar achieve-ment[4]	1
	10b	NASi	Master's seminar NASi	Master's seminar NASi				(2)				(5)		Seminar achieve-ment[4]	1
	10c	Opti	Master's seminar Opti	Master's seminar Opti				(2)				(5)		Seminar achieve-ment[4]	1
	11	MApA/ NASi/ Opti	Master's thesis	Master's colloquium					**25**				2.5	Oral examination (15 min) (10%) with Master's thesis (90%)	1
				Master's thesis									22.5		
		Total Master's seminar and Master's thesis (MA)			0	0	0	2	**30**	0	0	5	25		

[1] Students starting to study in the winter semester.
[2] Students starting to study in the summer semester.
[3] The ECTS credits are obtained by completing compulsory MApA modules worth 15 ECTS credits (compulsory modules) and the practical course (compulsory module), Master's seminar and Master's thesis in NASi or Opti.
[4] The seminar achievement consists of a presentation (70–80 min) and a presentation handout (5–10 pages).