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Course of Study-Specific Examination Regulations

for the Master's Course of Study

in Biomedical Engineering

at RWTH Aachen University

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Please note: This publication is an English translation. Only the German original of these regulations as published in the Official Announcements of RWTH Aachen University ("Amtliche Bekanntmachungen") is legally binding.

Based on §§ 2 (4) (16) of the Higher Education Act of the State of North Rhine-Westphalia (Hochschulgesetz; HG) in the version of the announcement dated September 16, 2014 (Law and Official Gazette of the State of North Rhine-Westphalia p. 547), most recently amended by Article 1 of the Act on the Membership of University Hospitals in the Employers' Association of North Rhine-Westphalia from June 30, 2022 (GV. NRW p.780b), RWTH Aachen University (RWTH) has issued the following examination regulations:

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I. General

§ 1
Scope of Application and Academic Degree

(1) These examination regulations apply to the Biomedical Engineering Master's course of study at RWTH Aachen University. They only apply in conjunction with the currently valid version of the General Examination Regulations (GER) in the relevant applicable version, supplementing it with an additional set of course-specific regulations. In cases of doubt, the provisions of the General Examination Regulations take priority.

(2) Students who successfully complete the Master's course of study are awarded the academic degree of Master of Science RWTH Aachen University (M. Sc. RWTH) by the Faculty of Medicine.

§ 2
Objective of the Course of Study and Language Provisions

(1) The overall educational objectives are set out in § 2 (1) (3) (4) GER.

(2) The course of study is taught in English.

§ 3
Admission Requirements

(1) A basic requirement for admission is a recognized university degree according to § 3 (4) GER.

(2) To meet the educational prerequisites and successfully complete the Master's course of study in Biomedical Engineering, the applicant must have the necessary knowledge evidenced by credit points (CP) in the following areas:

- A total of 90 CP from the areas of engineering, mathematics, and natural sciences.
- These 90 CP must include the subjects listed in the following table at the minimum level indicated.

Mathematics	Higher mathematics, including linear algebra (vector and tensor calculus, matrices, eigenvalues), analysis (series, differential and integral calculus, Taylor expansion, functions of several variables, Fourier analysis, ordinary and partial differential equations), and numerical methods (discretization, direct solution methods for linear systems of equations)	20 CP
Chemistry	Higher chemistry, including inorganic chemistry, organic chemistry, biochemistry, and physical chemistry	20 CP

Biology	Higher biology, including human cell biology, genetics, microbiology, molecular biology, human anatomy, and human physiology	20 CP
Physics & Engineering	Higher physics, including mechanics, electrical engineering, thermodynamics, nuclear physics, solid mechanics, statics, and dynamics	30 CP

In addition, all applicants are required to successfully pass the Graduate Record Examination (GRE) General Test (no more than two years old). Applications without GRE will not be considered. At least 160 points must be achieved in the quantitative part of this test. Applicants who are citizens of a member state of the European Union or of the European Economic Area (EEA) as well as “Bildungsinländerinnen” or “Bildungsinländer”, i.e. non-German citizens who have a German school leaving certificate or university degree, are exempt from this rule.

(3) For admission conditional on the completion of additional requirements, § 3 (6) GER applies. Admission to the Master’s course of study in Biomedical Engineering is not possible if

- due to the required educational background defined in paragraph 2, additional requirements corresponding to more than 20 credit points are imposed.
- in one of the subjects more than 50% of the required credit points are missing.

For admission to this Master’s course of study, applicants who are not native speakers of English and who have not acquired their university entrance qualification at an exclusively English-speaking institution must provide evidence of sufficient English language proficiency pursuant to § 3 (10) GER (the certificate must not be older than two years).

(4) When determining whether the admission requirements are met, § 3 (12) GER applies.

(5) General regulations for the recognition of prior assessments and exams are stipulated in § 13 GER.

§ 4
Standard Period of Study, Curriculum, Credit Points, and Scope of Study

(1) The standard period of study is four semesters (two years) full-time, including preparation of the Master's thesis. Students can only begin their studies in the winter semester.

(2) The program consists of mandatory modules, elective mandatory modules, and an internship. The internship regulations provided in the "Biomedical Engineering Master's program – Internship Guide" apply. For successful completion of the degree program, a total of 120 credit points must be acquired. The Master's examination is comprised of the following components:

Mandatory section	70 CP
Elective Mandatory Section	10 CP
Internship	10 CP
Master's thesis	30 CP
Total	120 CP

(3) The degree program, including the Master's thesis module, is comprised of 18 modules. All modules are specified in the module catalog. The weighting of the examinations with credit points to be taken in the individual modules is carried out according to § 4 (4) GER.

§ 5
Obligatory Attendance in Classes

(1) According to § 5 (2) GER, obligatory attendance can only be stipulated in courses of the following type:

1. Tutorials
2. Seminars and introductory seminars ("Proseminare")
3. Colloquia
4. Lab courses
5. Excursions

(2) Classes, for which attendance is required in accordance with paragraph 1, shall be identified as such in the module catalog.

§ 6
Examinations and Examination Deadlines

(1) General regulations on exams and exam periods are stipulated in § 6 GER.

(2) Provided that completion of modules, exams, or module components according to § 5 (4) GER is stipulated as a precondition for participation in other exams, this is indicated in the module catalog.

§ 7
Types of Examinations

(1) General regulations on types of examination are included in § 7 GER.

(2) The following other forms of examination are stipulated according to § 7 (1) GER:

(3) The duration of an exam is as follows:

- 60 to 120 minutes for up to 5 CP
- 120+ minutes for 6 or more CP

(4) Oral exams shall last a minimum of 30 minutes and a maximum of 45 minutes. The duration of a group exam shall be at least 20 minutes per candidate. An oral exam may be carried out as a group exam with up to four candidates.

(5) Term papers range from 10 to 15 pages. The writing-up time of a written term paper depends on the number of credit points it is worth. For each credit point awarded, a preparation time of 30 hours is assumed.

(6) The written version of the oral presentation shall range from 4 to 8 pages. The duration of the presentation shall be least 20 minutes and a maximum of 30 minutes.

(7) The following applies to colloquia: The colloquium/exam shall last a minimum of 30 and a maximum of 45 minutes.

(8) The following applies to the internship/practical experience in particular: The length of the internship report, which will be assessed, is 20 pages without references/appendices.

(9) The examiner specifies the duration and, if applicable, other modalities of the assessment at the start of the course.
Admission to module exams may be conditional on the successful completion of module components as examination requirements in accordance with § 7 (15) GER. For the relevant modules, this is outlined in the module catalogue. At the start of the semester, or by the first session of the course, the instructor shall provide the students with precise criteria online in the CMS regarding opportunities to improve their grades by completing module components, specifically indicating the number and type of tutorials that can be taken for extra credit and the methods of correction and assessment.

§ 8
Assessment and Grading

(1) General regulations for assessing the exams and the formation of grades are stipulated in § 10 GER.

(2) If an examination consists of several partial exams, each partial exam must be passed, i.e. be completed with the grade of at least "sufficient" (4.0).

(3) A module has been passed if all associated exams have been passed with a grade of at least "sufficient" (4.0), and all other credit points or module components have been achieved according to the relevant course of study-specific examination regulations.

(4) The overall grade is formed taking into account all module grades and the grade of the Master’s thesis according to § 10 (10) GER.

§ 9
Examination Board

The responsible examination board according to § 11 GER is the Biomedical Engineering Master's Examination Board at the Faculty of Medicine.

§ 10
Repeating Examinations or the Master's Thesis, Loss of the Right to Take an Exam

General regulations governing retaking exams or the Master's thesis, and the loss of the right to take exams are stipulated in § 14 GER.

§ 11
Deregistration, Non-Attendance, Withdrawal, Deception, Non-Compliance

(1) General provisions on deregistration, non-attendance, withdrawal, deception, or non-compliance are included in § 15 GER.

(2) The following applies to the deregistration from lab courses and seminars: deregistration from block courses is possible until three working days before the first day of the course.

II. Master's Examination and Master's Thesis

§ 12
Type and Scope of the Master's Examination

(1) The Master's examination consists of

1. examinations that are to be completed based on the structure of the course of study according to § 4 (2) and detailed in the module catalog, as well as
2. the Master's thesis and the Master's final colloquium.

(2) The order of courses is based on the curriculum (Appendix 1). The topic of the Master's thesis can be agreed on after completion of a total of 90 credit points and after the student has provided evidence of having completed the mandatory internship.

§ 13
Master's Thesis

(1) General provisions for the Master's thesis are stipulated in § 17 GER. The guidelines for the Master's thesis, entitled "Master Program Biomedical Engineering – Master's Thesis Guide" apply and must be followed.

(2) Further details regarding the supervision of the Master's thesis are outlined in § 17 (2) GER.

(3) The Master's thesis is to be written in English.

(4) The Master's thesis writing time is at least four months, at maximum six months, alongside studies. In justified exceptional cases, the writing-up time can be extended by a maximum of up to six weeks upon application to the relevant examination board in accordance with § 17 (7) GER. The thesis should not exceed 80 pages, excluding appendices.

The candidate presents the results of the Master's thesis as part of a Master final colloquium. § 7 (12) GER in connection with § 7 (7) apply accordingly.

(5) The work required for preparing and writing the Master's thesis as well as for the colloquium shall correspond to 30 credit points. The Master's thesis can only be graded after the Master's final colloquium has taken place.

§ 14
Acceptance and Assessment of the Master's Thesis

(1) General provisions on the acceptance and assessment of the Master's thesis are stipulated in § 18 GER.

(2) Three printed and bound copies of the Master's thesis are to be submitted to the Central Examination Office by the set deadline. Furthermore, the thesis must be submitted as a PDF file on a data carrier.

III. Final Provisions

§ 15
Viewing of Examination Records

Review of exam documents is carried out in accordance with § 22 GER.

§ 16
Entry into Force, Publication, and Transitional Provisions

(1) These regulations shall come into force as of the 2022/2023 winter semester and be published in the official announcements ("Amtliche Bekanntmachungen") of RWTH.

(2) These regulations apply to all students who are enrolled in the Biomedical Engineering Master's course of study at RWTH Aachen University.

Issued based on the decision of the Faculty Council of the Faculty of Medicine from January 31, 2022.

It is pointed out that, in accordance with § 12 (5) NRW HG, any claims regarding a violation of procedural or formal requirements of the regulatory or other autonomous rights of the University may no longer be asserted after one year has elapsed since the official publication of this announcement unless:

1) the announcement has not been properly published,
2) the Rectorate has objected, prior to publication, to the decision of the committee adopting the regulations,
3) the University has been previously notified about the defect of form or of procedure in a complaint, specifying the infringed legal provision and the fact which gives rise to the defect, or
4) the legal consequence of the exclusion of complaints was not pointed out in the public announcement.

On behalf of the Rector
of RWTH
Aachen University
The Chancellor
p.p.

Aachen, dated September 29, 2022

sgd. Tränapp

Thomas Tränapp

Appendix 1: Curriculum (Valid from Winter Semester 2022/23)

Semester	1				2				3				CP	Exam
Courses	L	S	E	P	L	S	E	P	L	S	E	P		
Chemistry/Biochemistry	2	-	1	1									5.0	GR
Medical Biology	2	-	-	2									5.0	GR
Anatomy/Physiology	2	-	1	1									5.0	GR
Ethics/Intellectual Property and Reg. Affairs	-	3	1	-									5.0	GR
Mechanics/Biomechanics/Fluid Mechanics	2	-	2	-									5.0	GR
Elective Mandatory Course	x	x	x	x									5.0	GR
Medical Imaging (Imaging Techniques)					2	-	-	2					5.0	GR
Control and Electrical Engineering					2	-	2	-					5.0	GR
Material Science and Processing					3	-	1	-					5.0	GR
Internship								x					10.0	GR
Elective Mandatory Course					x	x	x	x					5.0	GR
Image Guided Therapy and Theranostics									2	-	1	1	5.0	GR
Image Processing and Handling									2	-	2	-	5.0	GR
Art. Organs: Heart, Lung, Kidney, Liver support									2	-	-	2	5.0	GR
Advanced Biomaterials (Hard Tissue Implants and Prostheses & 3 D Bioprinting)									-	2	-	2	5.0	GR
Cell Culture and Tissue Engineering									-	2	-	2	5.0	GR
Systems Biology									2	-	-	2	5.0	GR
Elective Mandatory Course														
Introduction to Mechanobiology*	2	-	-	2					2	-	-	2	5.0	GR
Medical Statistics*	2	-	2	-					2	-	2	-	5.0	GR
Immunology and Microbiology*	2	-	-	1					2	-	-	1	5.0	GR
Bioinformatics*	2	-	1	-					2	-	1	-	5.0	GR
Experimental Medicine (Biom. Diagnostics)					-	2	1	-					5.0	GR
Biomechanics and Mechanobiology for soft biological tissues					1	-	2	-					5.0	GR
Optophysiology					2	1	-	-					5.0	GR
Optional Courses														
Neuroscience					-	1	-	-					2.0	P/NP
Pr. C. in Immunohistochem. Neuroscience	-	1	-	1	-	1	-	1	-	1	-	1	3.0	P/NP
Applied Physiology in connection to biomedical devices	-	1	-	-					-	-	-	-	2.0	P/NP
Selected topics of inelasticity theory	-	-	-	-					2	-	2	-	5.0	GR
Biomedical Products and Process Design	2	-	2	-					2	-	2	-	4.0	GR
Medical Statistics*	2	-	2	-					2	-	2	-	5.0	GR
Introduction to Mechanobiology*	2	-	-	2					2	-	-	2	5.0	GR
Immunology and Microbiology*	2	-	-	1					2	-	-	1	5.0	GR
Bioinformatics*	2	-	1	-					2	-	1	-	5.0	GR
MATLAB					1	-	2	-					5.0	GR
Selected topics in regard to Art. Organs					-	1	-	-					2.0	P/NP
Continuum Mechanics					2	-	1	-					5.0	GR
Porous Media Mechanics					2	-	2	-					5.0	GR
Technical organ support in Intensive Care					-	0.5	-	0.5					2.0	P/NP
Experimental Medicine (Biom. Diagnostics)					-	2	1	-					5.0	GR
Biomechanics and Mechanobiology for soft biological tissues					1	-	2	-					5.0	GR

Entrepreneurship		4	-	-	-		5.0	GR
Optophysiology		2	1	-	-		5.0	GR
Master Thesis (4th Semester)								
Master Thesis							25.0	GR
Master Thesis Colloquium							5.0	GR

*Elective Mandatory courses as well as Optional courses may be taken in the 1st or 3rd semester, except for courses with prerequisites.

Key: **L:** Lecture, **S:** Seminar, **E:** Exercise **P:** Practical Course, **P/NP:** passed /not passed **GR:** graded